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FOUNDRY TRADE JOURNAL

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New Approach to Education

If all the conferences and papers on foundry education which have appeared in the JOURNAL since 1902 were assembled into book form, it would indeed make a length equal to, or greater than, a Victorian novel. The earlier chapters would assume that management had been satisfactorily trained, except perhaps as to their lack of knowledge as to the needs of apprentices. The theme-song throughout the whole book would be the lack of suitable entrants to the industry and the stress laid upon it thirty, forty or fifty years ago makes one wonder what kind of training the present leaders of the industry obtained or how the industry has achieved its present size and status.

The closing chapters of the book would show that the problem of selection and training has been sensibly broken down into divergent channels, which is alike realistic and logical. They would also show that if the present executives are efficient, there are too few of them, especially in the technological field. This shortage of technologists has been emphasized by after-dinner speakers, using international (especially Russian) figures as a point of comparison. Sir George H. Nelson in his presidential address to the Institution of Mechanical Engineers believes that comparisons of the published ratios between the annual output of technologists in different countries and their populations are misleading. On the basis of the inclusion of but half of those who have qualified for the Higher National Certificate —broadly equivalent to graduate technologists—then the British figure is lifted from 57 to 120 per million of the population, which puts this country in a better light. Even then, though nearly equal to the American figure, the UK ratio is only half that of the Russian. For pure science, however, the figures given for 1954, again per million of population, show that whilst Britain trained 105, Russia turned out only 56. The unknown factor in all these cases is relative calibre of the graduates.

Strenuous efforts are being made by a section of the foundry industry to ascertain current and future needs and to establish what steps need to be taken for their fulfilment. This is not too easy, as even the requirements for each main division are varied. Some concerns demand increased assistance on the metallurgical side, whilst others require more and more help on engineering matters. Above all, the smaller concerns look—and often in vain—for an "all rounder"—a man who can select the best plant and operators to get an extra output, of constantly improving quality, from limited floor-space. Moreover, he must do this without the aid of a corps of specialists. The Victorian novelists tied up the loose ends very nicely at the end of their books, and the new approach to the training of foundry personnel may very well have the same happy consummation.

American Letter

British Cars Gaining in US

A. E. Birt, president of Hambro Automotive Corp. of New York, believes his distributing firm will sell 60 per cent. more British motor cars in the United States in 1958 than in the current year. The Hambro concern is the sole United States importer of all cars made by British Motor Corporation, which firm produces the MG, Morris, Austin, and Austin Healey cars. "Our sales target for 1957 is 25,000 units," Mr. Birt said, adding that the 25,000 sales mark for 1957 represented an increase of 150 per cent. over the US sales of British cars in 1956.

Shipbuilding

The Shipbuilders' Council of America reports that 102 vessels are on order equivalent to 3,300,000 d.w. including 85 tankers, five ore-carriers, four combination passenger cargo vessels and three dry-cargo ships. During August last, five vessels were launched, one of them a 26,000-ton tanker. The remaining work scheduled calls for the delivery of 13 more vessels in 1957, 36 in 1958, 35 in 1959, 15 in 1960 and three in 1961. New orders placed during August accounted for approximately 80,000 tons, including two tankers of 28,600 tons and one a Great Lakes ore carrier of 21,400 tons.

Aluminium

Dr. Herbert H. Haas and Earl R. Klinge, of Continental Aviation and Engineering Corporation, describe in the SAE *Journal* an air-cooled diesel engine for Army tanks. The cylinder-head is an aluminium casting of Alcoa 142-T75 copper/nickel alloy. The cylinder barrel is made of steel and is screwed and shrunk into the cylinder -head whilst the head is heated.

About 9,000 tons of secondary aluminium are consumed annually in America for the production of castings for "outboard" motors. There were about 750,000 of these motors in use 15 years ago; today they number more than 4½ million.

Lead

A comparison of world production of lead *versus* US consumption would help to explain weakness in the price of this metal. In 1957, world smelter production of lead is expected to reach an all-time record of 2,080,000 tons—an increase of 24,000 tons over production in 1956 and about double that of ten years ago. The United States is expected to lead this year with about 490,000 tons; the second largest producer is Australia, with an estimated production of 260,000 tons and USSR follows closely with an estimated production of 255,000 tons. Over the last ten years, however, US consumption of lead showed no increase, the total varying between about 900,000 and 1,100,000 tons. Employment of lead for battery making (at about 320,000 tons annually) is still almost double that used for alloying, though the latter is increasing.

Box-type Electric Furnaces. A catalogue issued by G.W.B. Furnaces, Limited, P.O. Box 4, Dibdale Works, Dudley, certainly demonstrates the versatility of the box-type of electric furnace, for it illustrates descriptions of plant installed for vitreous enamelling, ageing and solution heat-treatment, annealing and stress-relieving. The illustrations are remarkably clear, whilst the descriptions of parts of the plant are alike simple and informative.

UK Instruments in Düsseldorf

Continental scientists and engineers will be able to inspect the latest British developments in instrumentation for a wide field of research and industry on the official British stand at the first Interkama (International Congress and Exhibition of Measuring Instrumentation and Automation) at Düsseldorf, November 2 to 10. The stand is being organized by the Board of Trade in conjunction with 23 members of the Scientific Instrument Manufacturers' Association, who are providing a display of instruments and allied equipment.

The display will concentrate mainly on scientific and industrial equipment for measuring, recording and controlling, with considerable emphasis on electronics. It will also include, however, such equipment as colorimeters, ultrasonic inspection devices, precision balances, servo test and automatic-analysis equipment and nucleonic instrumentation, such as radio-active dust-sampling equipment. The British stand will cover more than 2,000 sq. ft. and will have an enquiry desk manned jointly by staff of the British consulate general in Düsseldorf and by representatives of SIMA. It will include small reception rooms in which United Kingdom exhibitors can interview prospective buyers.

British S.G. Iron Producer's Association

The British producers of spheroidal-graphite iron recently held a one-day technical conference in London. It was attended by nearly 100 delegates who included technicians, production executives and management. The conference was organized by the technical committee of the Association and was presided over by Mr. W. R. Cooper, chairman of the Association. Technical papers covering all aspects of melting, metal treatment, foundry production methods and casting applications were presented and fully discussed at four sessions.

The Association intends to maintain close technical liaison between members on common technical problems through regular meetings of technicians at similar conferences and the operation of an active technical committee which can maintain liaison with the Mond Nickel Company, Limited, and British Cast Iron Research Association.

Forty Years Ago

In the November, 1917, issue of the JOURNAL there was a report of an address by Sir Winston Churchill to a conference of Boy Welfare Supervisors. He told them that the Ministry of Munitions was the largest employer of boy labour and indeed of every kind of labour in the world. There were at that time more than 250,000 boys working under the authority of that department. He concluded with the statement that wherever there was a considerable body of young people engaged in industrial work there should be one man whose whole time, thought and hope was wrapped up in their care and guidance. Amongst new companies registered appeared the name of James Bridge Copper Works.

ALUMINIUM, LIMITED—A dividend of 22½ cents per share (US currency) on no par shares, payable on December 5 to shareholders of November 5, has been declared by the company. This is a new quarterly rate following the May 4 sub-division. A like rate was paid in September.

"Slagging" of Cupolas

By "Jacques"

Cupola slag handling and its disposal has come prominently into focus of late. The de-slagging phase of cupola practice has always been, and still is, a problem in a great many of the older type of foundry. It is an aspect of routine which, unfortunately, has long been left to take care of itself and is accepted as a traditional legacy. However, water-quenching systems for dealing with molten slag and permitting continuous granulation on an automatic basis can now be supplied as an "extra" to up-to-date cupola designs. In some cases, also, the extensive equipment has been very advantageously worked into existing layouts, where space and circumstances permit the economic disposition of the units. Where long or heavy daily "blows" in the furnace are the usual routine, the convenience, comfort and labour-saving brought about by easy slag-handling and disposal have to be experienced to be believed. Modern handling methods remove an expensive, unpleasant and often "sole-burning" chore, necessary after "dropping the bottom" of the furnace.

The adoption of water-cooling of cupolas has, in every case, very considerably reduced the total slag output per ton of metal melted. The employment of highly refractory grit and non-spalling ganister for cupola patching will also decrease the weekly tonnage of slag—slag which has to be broken up and often fork- or shovel-loaded by hand for transit to the tip. This daily disposal task is one where labour and cost per ton per mile may exceed the initial cost of the limestone used in the furnace for fluxing.

Usual Practice

On the "tap-out and bot-up" type of cupola in which molten metal is stored in the "well" between taps, the moment to open the slag-hole is a decision left to the experience of the cupola man. It is an unpleasant job and as such it is usually deferred until the last second, that is, until an eye-level observation through a tuyere "spy-hole" indicates that metal is on the point of entering the tuyeres and a rapid poking-out of the slag-hole stopping is due. Not infrequently, this job is carried out with a crowbar and sometimes a sledgehammer is needed.

In dozens of foundries to-day, the slag is still permitted to trickle out on to the floor, and the pool is contained inside a piled-up sand barrier roughly shaped near the cupola legs. The bubbling slag is covered over at intervals with a few shovelfuls of sand, to provide some sort of protection for the operators from the heat evolved.

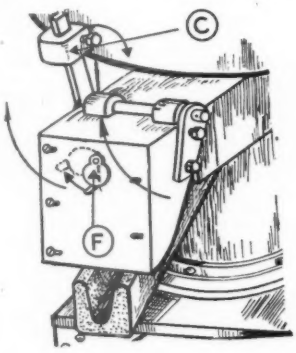


FIG. 1 (*right*).—*Sketch of a tip-up canopy for fixing over the slag-hole of a cupola to permit working with the hole continuously open during a melt, without danger from flying sparks and incandescent coke breeze.*

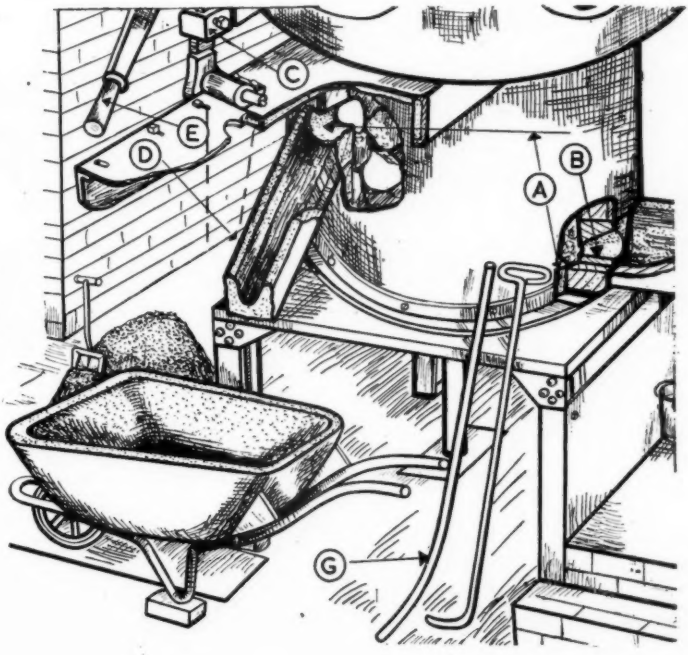


FIG. 2 (*above*).—*Slag-hole canopy in the closed—or operating—position.*

"Slagging" of Cupolas

Open-slag-hole Operation

It is quite a usual practice to leave the slag-hole open for the remainder of the "blow," though there are, of course, exceptions. However, an open slag-hole, under control, is always useful where high-duty, carefully-weighed charges of metal mixtures to specified compositions are being melted and high-duty iron is expected. An example of the open-slag-hole method of operation is described below; it can be confidently recommended as being consistently reliable after being proved over many years. In addition a description is included of a device which reduces danger to personnel from flying sparks and incandescent coke breeze ejected from the slag-hole.

With a home-made cupola designed to provide three tons per hr. of metal in 10-cwt. taps, run into the foundry's sole 10-cwt. receiving ladle, the metal-handling facilities in that particular shop were such that the ladle was returned to the cupola every 10 min. The charges of 5 cwt. were melted at the

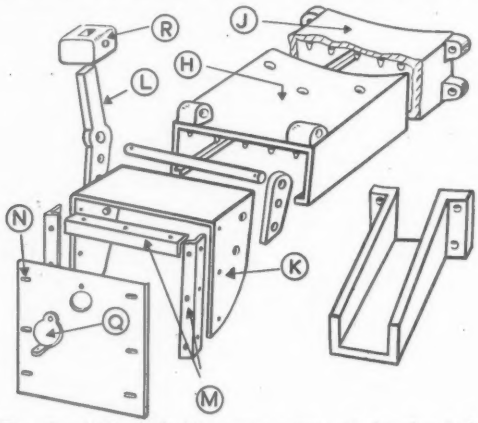


FIG. 3.—*"Exploded" arrangement of the slag-hole canopy showing the various components in detail.*

rate of approximately 1-cwt. per min. The furnace was provided with a 30-in. dia. well and the slag-hole was situated 20-in. above the well bed-line (shown at A, Fig. 1). The $\frac{5}{8}$-in. dia. tapered "quasi self-tapping" tap-hole was capable of emptying a full well of metal in under 3 min. It was, however, always botted-up just before completely draining the cupola well, in order to keep the inside end of the tap-hole clear of slag.

During the average melt on such a furnace, an open slag-hole can indicate (given keen observation) just how near the rising metal is to the slag-hole outlet. Metal approaching the slag-hole is indicated by a change in colour of the slag which flows hotter off the metal face as the level rises. Thus, when the slag reaches incandescence and is intensely fluid, it is at this point that it is essential to remove the tap-hole bot quickly with a pointed bar.

Hinged Baffle-plate

A continuously open slag-hole with full-blast behind it is not without risks because the blast roar of the furnace is accompanied by sparks and pieces of hot coke ejected from the slag-hole at high velocity. This danger can be almost completely eliminated, however, by fitting a tip-up canopy or baffle-plate arrangement to the slag-hole as shown in Figs. 1 and 2. The sketches are almost self-explanatory; the balance weight (C) is so placed that a flick with the bar used to open the slag-hole will lift the canopy clear of the gutter (D).

The lever (E) attached to the blast-control valve, handily designed so as to be near to the canopy, can be moved down to shut off the blast before opening or poking the slag-hole. As an alternative, the small circular sheet-metal shutter (F) will permit poking the slag-hole with the canopy in the closed position and blast full on, using the bent bar, (G), for this purpose.

Details of the Assembly

Fig. 3 shows an "exploded" assembly for the tip-up canopy. For the low type of cupola blast chamber, often referred to as the wind-belt, the cast-iron body section (H) of the canopy is fixed to the underside of the belt plate. Where the belt is well above the slag-hole, however, the lug type of section (J) is used, fixed to the cupola shell at a suitable height. In either case, the inside of the canopy is brick- and ganister-lined; the lug type of section being permanently fixed in position, requires very little fettling. The canopy section is bent from fairly-thick plate (K). The side levers (L) are made of cast iron and the other details (M) from any bits and pieces of steel angle or channel available, and fixed as shown. The front plate (N) is slotted and put into position on the angle sections which are riveted to the inside edge of the tip-up canopy. The sheet-metal plate (Q) is also put into position on the front plate. The balance weight can be moved up and down as required, as shown at (R). When assembling this canopy device, ample clearance should be allowed at all moving points, because the "looser" the fit, the easier the operation of the unit when it becomes hot. The inside of the canopy and all faces exposed to the hot blast issuing from the furnace are daubed with a pasty ganister, when fettling the slag-hole; distortion of the metal construction is then negligible. On the furnace illustrated, the steep angle of fall of the slag gutter will be noted, this item is also brick-lined and daubed.

Slag Disposal

As shown in Fig 1, a sand-lined barrow is employed taking away the slag; this is placed on a level base directly under the slag gutter. Steel or cast-iron wheels (not rubber!) are recommended for the barrow. Three to five barrows similarly prepared will take all the slag from a day's melt. On the morning following a melt, the loaded barrows are run up a ramp having an easy slope and emptied direct into a tip lorry.

For receiving the slag at the cupola, bodies of ordinary steel barrows are first well wetted and then lined about 2-in. thick with a damp floor-sand. Molten but slow-running slag, as it comes from the furnace, rolls over this sand lining in the barrow without penetrating it, as it does not possess the "cutting" action of molten metal. A time of five minutes per barrow for applying the sand lining is quite normal. This now well-established method of dealing with cupola slagging has saved hundreds of man-hours of overtime and the heavy labour involved in breaking up the slag on the floor and hand-shovelling in on to the lorry.

Botting the Slag-hole

At the commencement of operations, it is important to stop-up the slag-hole a short time before blowing commences if quick and easy opening-out subsequently is to be desired. The sand stopping should be inserted flush with the inside face of the cupola lining, and, to provide a base against which to ram the sand, quite a usual practice is to toss small pieces of coke into the slag-hole and push them further with the bot-stick. Balls of wet sand are then quickly thrown into the hole (where they dry rapidly) and can be rammed hard to form a substantial plug that will withstand the full pressure of the blast later. With this method of plugging the slag-hole, it sometimes happens that just a fraction-too-big a piece of coke sticks in the centre of the tapered slag-hole. If the sand plug be then rammed only as far as this piece of coke, the space beyond it will later fill with slag and solidify into a barrier so hard that a crowbar and sledgehammer may be necessary to drive it through into the furnace to clear the hole. The delay so incurred may give time for rising slag and metal to flow into the tuyeres or the wind belt, unless in the meantime metal can be drawn off from the well. To avoid the possibility of slag-hole blockage in this manner, a useful proviso is to set a small piece of glass over the hole from the inside when patching the furnace and making ready for the "blow." Then, just before "metal down" a sand bot can be rammed from the outside flush up to the glass. When it is required to re-open the slag-hole, the sand and any glass still there can be picked out without difficulty. While the fire is burning up, during the make-ready for a melt, the loss of natural draught due to a closed slag-hole is negligible as open tuyeres will provide all the inlets necessary. It may be that, with a very briskly burning fire, the glass may crack or perhaps melt, but before that can happen the hole should have been plugged with sand from the outside. Another way of providing a backing for the slag-hole plug is to insert small pieces of wire or thin sprigs beforehand into the daubing and over the hole as an alternative to the glass. Later, a thin ball of wet paper when quickly pushed into the slag-hole as far as the wires and rapidly followed by a sand bot is quite effective.

No dimensions are quoted for the gadgets described in this article, as these can be computed to suit individual requirements and the design of the particular cupola employed. A further refinement on the use of lined slag-barrows is the provision of lined tipping-bins and a monorail on which they can travel direct to a ramp and "tip," the latter being located in an area where all the foundry rubbish taken out from the moulding and other departments is dealt with. Any scheme which removes at least one shovelling operation from the foundry floor into a lorry will substantially cut down the cost of handling foundry rubbish.

House Organs

Aluminium Courier, No. 38; issued by the Aluminium Development Association, 33, Grosvenor Street, London, W.1.

This issue carries an article on the use of aluminium for ships' fittings. The range described and illustrated is indeed wide, and includes funnels, masts, accommodation ladders, life rafts, sea-water buoys, marine diesel engines, cylinder-blocks, davits and window frames. This is very interesting information as, in certain quarters, there still exists a prejudice against the use of aluminium for marine applications. In anticipation of such objections, there is a second article on "Aluminium Fittings in Contrast with other Shipbuilding Materials," which is full of useful suggestions.

Foseco Foundry Practice, No. 128; issued by Foundry Services, Limited, Long Acre, Nechells, Birmingham, 7.

An inset on page three of this number reminds readers that the firm has now been established 25 years and it is no idle boast to claim that it now spans the world. There is an interesting article on a defect in a brake-drum casting, due to the presence of coarse graphite, and worth-while recommendations are included for putting production of this component on a sound basis.

Electricity in Industry, No. 13; issued by the Lancashire Dynamo group of companies.

An interesting article in this issue covers an instrument devised within the group, which automatically gives an alarm when smoke emitted from a stack exceeds a predetermined density. This, of course, ties up with conformity with the provisions of the Clean Air Act, when the Regulations come to be applied—that is, within the next seven years.

Broomwade News Bulletin. Vol. 30, No. 4; issued by Broom & Wade, Limited, High Wycombe.

The firm announces a new model of a dry-cylinder, carbon-ring air-compressor. Known as C660 it is of the single-stage, single-acting type and delivers 255 cub. ft. of free air per min. at 60 lb. per sq. in.

Recent Wills

JOHNSON, W. L., of Birmingham, metal merchant ...	£19,759
BEWLAY, MAJOR C. J., of Holmrook (Cumberland), retired shipbuilder	£25,185
CLANCY, L. M., a director of Thorn Electrical Industries, Limited, London, W.C.1	£3,521
BALDWIN, W. T., chairman of Baldwin & Francis, Limited, switchgear manufacturers, of Sheffield...	£25,951
MEDLEY, T. C., a director and secretary of S. J. & E. Fellows, Limited, holloware manufacturers, etc., of Wolverhampton	£31,835
GRAZEBROOK, W. H., formerly a director of M. & W. Grazebrook, Limited, heavy general and chemical engineers, etc., of Dudley (Worcs)	£23,794
MILLARD, A. E., formerly managing director of Walsall Conduits, Limited, West Bromwich, which he joined as an office boy and served for 51 years	£57,446

Better Housekeeping Pays

By efficiently controlling the "housekeeping" of their foundry at Tyseley, Birmingham, the Midland Electric Manufacturing Company, Limited, are able to maintain a high standard of cleanliness and good order. The firm, according to *Target*, claims that improved working conditions have contributed to stabilization of labour and increase in output.

Much dirt has been prevented by correct adjustments of equipment and care in loading conveyors and wheelbarrows. Conveyor structures are cleaned daily and process dust is carried away from the general shop atmosphere. Gangways give access to the general structure and upper parts for regular cleaning. The dust from parts difficult of access is removed by pneumatic methods whilst vacuum cleaners are used on the floor. Parts difficult to reach are cleaned once a month, and accessible ones daily. A sweeping machine clears the iron tiles and concrete floor around cupolas twice daily. Windows are cleaned fortnightly on a rota system and the self-cleaning roof-lights are washed with dilute acid every 18 months to remove stains; electric-light fittings are dismantled and washed once a fortnight.

The use of aluminium paint ensures good reflection of light and quick detection of wear and tear. The whole of the foundry is repainted every six months. Nothing is stacked against walls or placed on window-ledges. Litter bins and clothing lockers are provided, and gangways kept clearly defined with white lines.

Six men—two sweepers, two painters and two cloak-room attendants and cleaners—are employed at an annual average cost of £3,150. With a total annual output of 3,000 tons, the cost of good housekeeping works out at about £1 1s. 0d. a ton. This cost is regarded as an investment yielding high savings and improvements in planning and production.

Chinese Mission to Study UK Industry

A Chinese technical and economic mission arrived in London last week to start a study of British industry and the type of goods Britain might sell to China. Among the industries in which the 20 members of the mission are interested are machine tools, precision instruments, electronic equipment, automobiles, and chemical engineering plant. Invitations have been received from about 1,500 companies, but the mission will be able to visit only about 3 per cent.

Dr. Ch'I Chao-ting, the leader, said he would like to see trade between the UK and China normalized. There were still many important items which China was unable to buy from Britain because of the strategic list. The mission would not place any specific orders during its stay, he said.

Plant Expansion in US

Business spending for plant and equipment in America is expected to recede in 1958, the exception being spending on public utilities. A survey of present schemes shows that plant and factory construction, now running at the rate of 37 billion dollars annually, may be expected to decrease by from 10 to 20 per cent. during 1958. The rate of expenditure for 1956 was 35 and for 1955, 28.5 billion dollars. The reasons put forward for the recession are that earlier programmes have been completed; that capacity to produce exceeds needs, and that uncertainty as to the future prescribes caution.

Forthcoming Events

NOVEMBER 1

Institute of British Foundrymen

West Wales section:—"Production Problems in the Manufacture of Alloy-iron Castings," by W. M. Lord, B.Sc., 7 p.m., at Richard Thomas & Baldwins, Limited, Landore, Swansea.

Institution of Mechanical Engineers

Internal Combustion Engine group:—Symposium on engine testing: "Test-bed Installations and Engine-test Equipment," by H. G. Freeston; "Type Testing," by Lt.-Col. R. A. Lawrence and W. H. A. Collins; "Statistical Methods Applied to Engine Testing," by W. R. Buckland, B.Sc. (Econ.), Ph.D., 4 p.m., at 1, Birdcage Walk, Westminster, London, S.W.1.

NOVEMBER 2

Institute of British Foundrymen

Wales and Monmouth branch:—"Production Problems in the Manufacture of Alloy-iron Castings," by W. M. Lord, B.Sc., 6 p.m., at the Engineers' Institute, Cardiff.

East Midlands branch:—"Casting Finish, Tolerance, and Precision," by C. A. Sanders, 6 p.m., at the College of Technology and Commerce, Leicester.

NOVEMBER 4

Institution of Production Engineers

Liverpool graduate section:—"Jig and Tool Design," by A. V. Howland, 7.30 p.m., at the Stork Hotel, Queens Square.

Institute of British Foundrymen

Lancashire branch:—"Running and Feeding of Castings," by W. Collinge, 7 p.m., at the Midland Hotel, Manchester.

Sheffield and district branch:—"Patternmaking," by B. Levy, 7 p.m., at the Sheffield College of Commerce and Technology, Department of Engineering, Pond Street.

NOVEMBER 5

Institution of Works Managers

Leicester branch:—"Doctor in Industry," by Dr. P. Tyson Davidson, 7.30 p.m., at the Grand Hotel, Rugby (joint meeting with the Northampton branch).

Incorporated Plant Engineers

London branch:—"Lighting Installations for Industry," by W. Robinson, B.Sc., 7 p.m., at the Royal Society of Arts, John Adam Street, Adelphi, Strand, London, W.C.2.

Institution of Chemical Engineers

Ninth Hinchley Memorial Lecture: "An Education for our Times?" by Dr. R. P. Linstead, C.B.E., F.R.S., 6.30 p.m., at the Geological Society, Burlington House, Piccadilly, London, W.1.

NOVEMBER 6

Institution of Works Managers

Leicester branch:—"Supervisory and Management Training," by J. R. Armstrong, 7 p.m., at the Bell Hotel (joint meeting with the Incorporated Plant Engineers).

Incorporated Plant Engineers

Edinburgh branch:—"The Clean Air Act," by T. M. Ashford, 7 p.m., at 25, Charlotte Square.

Southern branch:—"Road and Internal Transport with its Associated Equipment": Brains Trust, the panel to consist of F. V. Wood, H. A. Chapman, H. J. Babbage, and J. Stelling, 7.30 p.m., at the Polygon Hotel, Southampton.

NOVEMBER 7

Institution of Production Engineers

Reading section:—"Lubrication in all its Aspects," by S. E. Holmes, 7.30 p.m., at the Canteen, Transport Equipment (Thornycroft), Basingstoke.

Institute of Metals

London local section:—"Refractories," by J. White, D.Sc., 7 p.m., at the Royal School of Mines, South Kensington, London, S.W.7.

NOVEMBER 9

Institute of British Foundrymen

West Riding of Yorkshire branch:—"Mechanical Aids to Shell Moulding," by D. H. Scott, 6.30 p.m., at the Bradford Institute of Technology.

Newcastle branch:—"Two Interesting Castings," by N. Charlton and C. J. W. Hayhurst, 6 p.m., at the Neville Hall, Westgate Road.

Scottish branch:—"Common Causes of Scrap in USA and Canada," by C. Saunders, 3 p.m., at the Royal Technical College, George Street, Glasgow.

Origin of the CO_2 Process*

During the session on CO_2 moulding and coremaking at the recent International Foundry Congress in Stockholm an account was given in which it was made clear that the invention originally was pioneered by British technicians—a Patented process which lapsed only because founders in general failed to appreciate its possibilities. In what follows the whole development is put into proper perspective.*

Like all moulders, Andrew Poulson (attached to the Widnes Foundry, in the second half of the 19th century), knew that large quantities of sand regularly became burnt and so, unsuitable for use. This, he felt, could be remedied and he conceived the idea of employing artificial and rapidly-effective bonding agents, and discussed the notion with the Hargreaves Brothers, at that time together as chemical and metallurgical consulting engineers.

James Hargreaves had been occupied in 1867 with researches into the production of aluminium and silicates and several of his innovations had involved the controlled use of large volumes of gases. Moreover with his wide acquaintance with the whole field of applied chemistry he probably knew that sodium-silicate had been used by Kuhlmann of Lille and Ransome of England as a binder in the manufacture of artificial stone from sand, various hardening agents being employed to decompose the silicate.

The individual contributions of Andrew Poulson and the Hargreaves brothers to the invention of the CO_2 technique cannot at this late date be resolved, but the outcome of their experiments was the discovery that sand, impregnated with sodium-silicate after brief exposures to carbon dioxide gas, set to a hardness normally achieved only after hours of costly heating.

The problem was solved and in the May and July of 1898 a group of three patent specifications were filed. These were B.P. 11,847, 14,498 and 15,619/1898. They described all the essential aspects of the new invention and extended claim to such variants as the use of aluminate in place of silicate and the incorporation of solid sources of CO_2 with both silicate and aluminate.

Unexplained Lapse

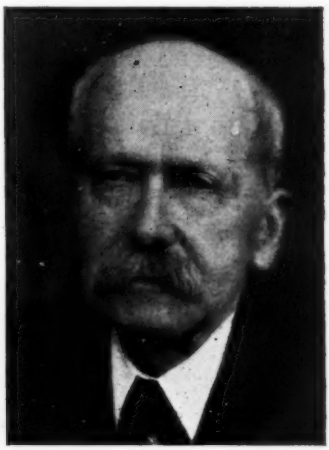
In the years that followed, trials of the process were carried out at Widnes which confirmed its practical utility. But apart from certain tentative and apparently unsatisfactory experiments by an

(*Continued on page* 522, *col.* 2)

* Abstracted from an article by J. R. Platt, A.M.I.Mech.E., and D. W. Hardie, B.Sc., Ph.D., appearing in the *Journal of Research and Development* of the British Cast Iron Research Association

Andrew Poulson was born in Liverpool in 1871 and served his apprenticeship at Scholesbridge Foundry. In 1869 he came to Widnes and within a few years was put in charge of the moulding department of Widnes Foundry which at this time had contracted to make a number of segments for the tunnels of the London Underground. A man of all-round abilities he was responsible for a hot-blast cupola which apparently fulfilled its inventor's hopes and claims and took its place among his many achievements.

James Hargreaves was born in 1834 near the Pendle Forest. Determined to make a career in industrial chemistry, he worked for six years in William Gossage's soap works at Widnes. There followed an interlude at Darlington where he attempted to interest the metal industry in his modification of the Bessemer steel process. Returning to Widnes he was joined by his younger brother John and together they set up as chemical and metallurgical consultant engineers.



John Hargreaves (1852—1942) was the younger brother of James Hargreaves with whom in 1871 he set up business as a chemical and metallurgical consultant engineer. He was one of the principal founders of the Society of Chemical Industry. With his brother he worked in close collaboration with Thomas Robinson (1814-1901), a local ironmonger, an association which proved fruitful in chemical engineering innovations, among them the once well-known Hargreaves-Robinson saltcake process.

Czech Foundry Developments

Further Research in CO_2 Practice

A booklet entitled "Progressive Methods in the Foundry" issued by VUMT (the Czechoslovak Research Institute for Materials and Technology) records particulars of work recently carried out by members of that organization. Subjects dealt with include "Precoated Sand Mixtures for Shell Moulding"; "A Review of Czech Moulding-sand Resources"; "Exothermic Sleeves for Risers"; and "Heat-resistant Silicon Cast Iron."

CO_2 Practice

The three articles on CO_2 practice in Czechoslovakia which the booklet contains are abstracted briefly in what follows:—

Rational Production of Precision Castings in Chemically-hardened Moulds

A device is described which permits the production of chemically-hardened flaskless moulds on a standard type of moulding machine. The production of small castings in flaskless moulds is reported to involve several considerable advantages *viz:*—

1. The chemically-hardened mould follows precisely the shape of the pattern and thus enables the production of castings with higher dimensional accuracy.

2. The height of the mould can be considerably less than with green-sand moulds and the consumption of the moulding mixture is thus decreased by 30 to 50 per cent. The physical fatigue of the machine operator during the production of moulds also decreases.

3. Chemically-hardened moulds permit the application of the stack method of casting even in cases where it is normally impossible, because of the low strength of ordinary sands, and result in labour-saving, higher output per unit area of working space, and a rise in metal/casting yield. Apart from these advantages, the use of the device makes possible the mechanization and, eventually, the automation of the production of flaskless moulds or cores.

Description of the Device

A patternplate with an auxiliary box is mounted on the basic frame of the device. Inside the frame there is the pressure plate to which ejectors are screwed. Carbon dioxide is introduced into a slit under the patternplate and openings in the patternplate are arranged to connect with this slit. After the mould has been squeezed and hardened it is pushed out of the device by means of the ejectors in a similar way to shell moulds. The pressure plate with the ejectors is itself lifted by means of the ejector pins of the moulding machine. The sequence of operation for mould production is thus: (1) The patternplate is cleaned and the auxiliary box filled with sand; (2) the pressure-plate is turned into the operational position, the sand is levelled and the mould is squeezed at the same time; (3) vibration; (4) the mould is hardened with carbon dioxide and the pressure plate returns into the original position; (5) the mould is pushed out of the device, and (6) the mould is taken off and the ejector dropped into the original position.

This article concludes with the statement that a similar system to that described may be used for the manufacture of cores where the design is suitable.

Blowing Cores of Chemically-hardened Sands

Moulding mixtures prepared according to Czechoslovak Patent No. 81931 from silica sand and water solutions of alkali silicates and hardened with carbon dioxide, are reported to represent an ideal moulding material for making blown or "shot" cores. Their main advantages are:

(1) The moulding mixture has very low green-strength before hardening and, therefore, its "blowability" is excellent.

(2) A blown core is hardened by passing carbon dioxide through it before the corebox is opened. A completely hardened core is taken out of the corebox and there is no need to transfer it to a dryer, and it is impossible to insert it into the mould immediately.

(3) The core has high strength after hardening—the compression strength being about 142 lb. per sq. in.—and for this reason the opening of the corebox may be "automatized" and the core pushed out of the corebox by various mechanical devices.

(4) Thanks to their high strength after hardening most cores can be used without core irons.

(5) The moulding mixture is said to be considerably cheaper than core mixtures containing oils or synthetic resins.

(6) The core does not stick to the corebox and it is not necessary to spray the corebox with petroleum or similar release agent.

(7) For the production of chemically-hardened sand cores all models of so-called "core-shooters" are most suitable. In these machines the sand mixture is squeezed into the corebox by the impact of compressed air, the function of which is similar to that of a piston. On the other hand, coreblowers in which the core mixture is blown into the corebox by means of compressed air may be used for this purpose, but greater abrasion of coreboxes must be expected. It sometimes happens, however, that the binder of chemically-hardened mixtures becomes separated at high speeds of flow and the core then sticks to the wall of the corebox. With

a coreshooter, it is possible to use wooden coreboxes, these being vented by perforated inserts in certain cases, *e.g.* when making cores with a blind part. Wooden coreboxes must be protected by nitro-cellulose varnish.

A coreshooter of an older type is next described in the article, as being very suitable for the purpose of producing CO_2 cores. Carbon dioxide is introduced into the corebox through a pneumatic clamp and a hole in the corebox wall. The clamp of the core-shooter is lined with rubber and thus sufficient tightness is achieved and loss of carbon dioxide is prevented. Carbon dioxide passes from a cylinder through an electrically-heated reducing valve at a pressure of two atmospheres. The amounts of carbon dioxide are regulated by means of the foot-operated reducing valve. For mass-production of cores of the same type, it is necessary to use automatic dispensers which supply carbon dioxide for a certain time, adjustable on the dosing equipment. With the cores of this size, the time of hardening changes from 5 to 10 sec. Cores for steel castings are blown with a mixture having pure silica sand as its base, *e.g.* a sand with 3 per cent. sodium-silicate addition of density 48 to 50 deg. Bé. The total moisture of the mixture after the treatment with sodium silicate shall be from 2.0 to 2.2 per cent. Cores for grey-iron castings and malleable-iron castings are made of a mixture of silica sand with grain distribution mainly between 0.1 to 0.3 mm. and a 2 to 5 per cent. coal-dust addition with above-mentioned limit because the strength of the 2 to 3 per cent. sodium silicate, the final moisture of this mixture being 2.5 per cent. If the resulting moisture of the sand is higher than quoted it is dangerous because the core might stick in the box and it might also "blow" when metal is poured. The content of waterglass must not exceed the above mentioned limit because the strength of the cores would be too high after pouring and they would be difficult to shake out. For light-section malleable-iron castings a mixture with 2 per cent. sodium silicate and 5 per cent. coal-dust is used. A coal-dust addition also improves collapsibilty of cores.

With other types of coreblowers the cycle is carried out in a similar way. For mass-production it is recommended to mount the corebox to the clamp very tightly and the clamp with the corebox should open only to such an extent as to enable the direct removal of the core. In this way, unnecessary manipulation of the coreboxes is eliminated. Further speeding up can be achieved by using ejector pins, by means of which the core is automatically removed from its box.

CO_2 Casting of a Cast-steel Crown-wheel for a Dredger

When using CO_2 practice, the production of a cast-steel crown-wheel for a dredger differs in principle from current methods practised and the method is described as suitable for mass production. The drag was first manufactured by "sweeping" and bricking fireclay bricks. This part of the mould was then used for locating inner and outer cores made of a chemically-hardened sand mixture.

The cope was also made of the chemically-hardened sand mixture but for this a cement-sand backing was made by "sweeping." The cores and the cope were hardened with CO_2 and for this purpose a battery of six cylinders was used. This battery was fitted with a heating body, a reducing valve and perforated nozzles for CO_2 injection into the sand having their own shut-off valves. Neck cores were used in order to facilitate the riser removal on the crown of the casting.

The gating system consisted of fireclay runners, in order to ensure the purity of the molten metal entering the mould. On this job the application of exothermic sleeves resulted in a high yield, *viz:* rough casting weight, 5 tons; feeder-head weight, 1¼ tons; metal yield, 74.3 per cent. of the total.

It is concluded that the method of production detailed proves the possibility of making complicated and heavy steel castings in CO_2 sand mixtures and the claim is made that production was doubled.

Sand-testing Equipment

At the engineering exhibition held at Brno, Czechoslovakia from September 1 to 29, a section was devoted to foundry equipment and supplies. Here the JOURNAL correspondent noted two items of sand-testing equipment developed by the Foundry Research Section of the Czech Research Institute for Materials and Technology, which operated on principles somewhat different from those which are now almost standard in this country.

Moisture Apparatus

The first item inspected was a moisture-determination apparatus, where the sand to be tested is mixed with calcium carbide in a rubber box; the acetylene gas developed during the chemical reaction between the carbide and the water present escapes into the atmosphere and the moisture content is recorded by the difference in weight of the sample before and after the reaction. The rubber box renders possible good mixing of the materials to be tested and the calcium carbide. The weighing of the sample is effected directly in the apparatus itself and the sample taken may vary between 30 and 30.5 gm. without any significant effect on the results. Two measurement ranges are available, the accuracy of the instrument being 1.5 per cent. of moisture in the range of 0 to 10 per cent.; 20 gm. of calcium carbide is required for each determination, which, it is claimed, can be completed in about 1½ min.

Universal Apparatus

The second piece of apparatus is designed for use in foundry laboratories to ascertain and register curves of load/compression of moulding substances. A standard sample of sand is inserted in a vertical position between two parallel pressure plates and special devices, it is stated, permit measurement of tensile strength, transverse, shear and jolting factors.

G

Czech Foundry Developments

A spiral spring fixed in the arm of the apparatus forms the basis of the measuring element. The test sample, situated under the spring, is mechanically pressed when the arm moves down; the apparatus being normally power-driven although hand-operation is possible. The pressure of the springs measuring the load is shown by a clock-indicator and a hand-lever secures the release of the arm. The jolting test is effected by means of a hand-lever on a jolting device. Three interchangeable spiral springs are available for loads of one, eight and 40 kg. respectively and there are also exchangeable clock-indicator dials with respective ranges up to 0.7 lb. per sq. in. with the 1-kg. spring to 6 lb. per sq. in. with the 8-kg. spring and to 30 lb. per sq. in. with the 40-kg. spring.

New Factory for Manufacturing Dust-control Equipment

Dallow Lambert & Company, Limited, have opened, at Thurmaston, Leicester, one of the most modern factories in the country exclusively devoted to the manufacture of dust-control equipment. Based upon a site of 10 acres, the first stage of the project (Fig. 1) has been completed with a building floor-space of 56,000 sq. ft. The office and factory layout was defined by the architect only after careful study of the firm's system and method of producing dust-control equipment for industry. A business "flow-sheet" was first outlined and the progress from inquiry stage to completion of contract carefully scrutinized. Thus the office block consists of four wings surrounding a lawn quadrangle. With the exception of the directors' suite and conference room above the entrance hall, the whole building is on the ground floor. However, to cater for future expansion, it has been designed so that a complete first-floor can be added on all four wings and there is sufficient space behind the factory to allow large expansion of the works.

Layout

Inquiries for the company's equipment are received by the sales department of the firm and then passed to the engineering department for thorough analysis of the particular dust problem involved, before specification of the equipment proposed. Consequently, a "small-particles" laboratory—in which the various dust samples received are subjected to detailed investigation of their chemical properties, physical reactions and general size-distribution—is sited between the technical sales department and the drawing office. In the layout scheme, the latter precedes an extremely well-equipped demonstration bay, where the company's latest developments in both wet dedusting and fabric filtration are critically tested, with a view to greater refinement and also obtaining an assessment of equipment behaviour on a working scale.

These processes occupy the north and west wings of the office block; research and development work of a more fundamental nature is carried out in a separate building and isolated from the routine business activity. The south wing of the main office block houses cost and works control staff and the east wing contains two large dining rooms (plus a small dining room for visitors) all served by a central well-equipped kitchen; the two large dining rooms can be combined to form an assembly hall or cinema.

The office partitions are completely interchangeable to permit rapid and smooth adjustment of office areas, very necessary in a business geared to meet the immediate needs for dust control of a wide range of basic industries themselves subject to rapid development. Steel partitioning constructed in 3-ft. sections has been used throughout and accessible ducts, housing electric and internal and external telephone circuits, run under every office floor. Noise has been reduced to a minimum by cork floors and acoustic-lined ceilings, and particular effort has been made to ensure that nearly all offices have, at some time during the day, direct sunlight. In the works, lighting, both natural and artificial, has been arranged to give generally shadowless working conditions and low vertical windows on the south wall provide an uninterrupted view of the grassland and trees at the rear of the site.

FIG. 1.—*Exterior of Dallow Lambert & Company's new factory at Thurmaston, Leicester.*

Equipment and Supplies

Dumptruck

Details of a new hydraulically controlled, diesel-engined dumptruck have been released by Thwaites Engineering Company, Limited, Cubbington, Leamington Spa. With an 18-ft. turning circle, the truck has been designed as a mobile carrying unit with any number of detachable skips, making available a machine that can pick up, transport, and discharge without splash, large quantities of material (up to one ton per cycle), without the operator leaving his seat, or having to wait for his skip to be filled. The standard skip will carry 14 cub. ft. of heaped sand and the unit can operate as an ordinary dumper, tipping in the normal manner. The truck can also carry side-discharge pouring skips of the same capacity; it is to be exhibited for the first time on stand 415 in the Building Exhibition at Olympia.

"Titanite"

"Titanite" is not new. It has been manufactured by the Constructional Engineering Company, Limited, Titan Works, Charles Henry Street, Birmingham, 12, for many years. In the foundry industry, it has been popular for making patterns, and one concern has used over 220 tons of this stone-like material. What is new is that it is being applied to other industries, and is now being extensively used for models for die-sinking. It also has many applications in the plastics and fibre-glass industries and a newly issued leaflet (No. 212) illustrates its use for the production of the hull for an 18-ft. launch, made from fibre-glass. The mould for the hull, measuring 20-ft. long, weighed over 3 tons. The balance of components for this launch were also made from "Titanite" moulds. The illustration shows a model in this material used for a Coronation medallion. The applications cited form excellent examples of a material being developed for one industry and finding extensive application in other trades.

FIG. 1.—*A model of "Titanite" used for a Coronation Medallion; its diameter is about 1⅛ in.*

Portable Resuscitator

A "resuscitator," for applying artificial respiration in cases of gas poisoning, drowning, electrocution, etc., is now being marketed by the medical division of British Oxygen Gases, Limited. It is known as the "Minuteman," weighs only 28 lb., and is claimed to be simple in operation. The machine, which is little bigger than a small travelling case, embodies a valve attached to a breathing mask which is held in the hand, and the power to operate it comes from the pressure in the oxygen cylinder. The double action of the equipment—both supplying oxygen to the lungs and assisting the return of blood to the heart of a patient—is automatically controlled by the patient's lung capacity.

Centralized Lubrication

Centralube, Limited, Great Western Trading Estate, Park Royal Road, London, N.W.10, have recently placed on the market what they call the improved Multiminor. It is a small piece of apparatus for centralized lubrication for use with either grease or oil. A downward movement of a lever attached to a cylinder about 6-in. high and 2½-in. dia., effects lubrication at up to eight points. The new model carries a de-aerating screw to overcome air-locks and a locking bracket to hold the lever between operations.

Fork-lift Truck

Ransomes, Sims & Jefferies, Limited, Orwell Works, Ipswich, have introduced a prototype "NR" 15, fork-lift truck, production of which is expected to commence early 1958. The unit, of which the design follows that of the FL.10, is capable of carrying 1,500 lb. at 20-in. load centre or 1,600 lb. at 16-in. A large battery of 278 amp.-hr. capacity is incorporated, to cater for the increased load capacity, and the style of the ballast-weight mounting permits a very small radius of turn.

Grommet-V-belt

Frank Wigglesworth & Company, Limited, of Shipley, Yorkshire, announce the introduction of an improved design of V-belt, reinforced by means of integral grommets, and marketed under the trade name of "Texrope." Incorporation of these reinforcements is claimed to result in the following advantages: increased life; cooler running; higher strength and shock absorption; less stretch and slip, and increased grip in the pulley, or drive.

Tractor/Loader

A new loader, which would seem to be particularly suited to foundry sand handling, is to be shown for the first time at the Building Exhibition, Olympia, from November 13 to 27 by J. C. Bamford (Excavators) Limited, Lakeside Works, Rocester, Staffs. One of the main improvements of this machine (Fig. 2), termed the "Loadall," over its predecessor (the J.C.B. Major Loader) is the incorporation of power crowd when using the bucket. This hydraulic operation, it is claimed, gives complete control over the digging and discharging of materials, and also enables the operator to dig below ground level. The powerful rams, with which the loader is equipped, result in a breakout force of 4,000-lb. Its capacities include a maximum discharge height of 9 ft., a forward reach at maximum discharge height of 2 ft. 6 in., and a range of buckets from ½ to 1½ cub. yd. Another great advantage claimed is that the Loadall device can easily be taken off,

FIG. 2.—*Hydraulic loader newly developed by J. C. Bamford (Excavators) Limited.*

leaving the tractor available for other work. The machine can be used for stockpiling (in particular, coke and coal), and can speedily and efficiently carry sand and other materials from stockpiles to the working floors.

Chain Hoist

A new electric chain hoist in the Munck range is being marketed by Taylor Stoker, Limited, of 189 to 191 Drummond Street, London, N.W.1. The unit (Fig. 3) is suitable for handling loads up to 6 cwt., whilst with an alternative design, with the lifting chain doubled, the load can be increased to 12 cwt. The simple hook suspension enables the unit to be hung from any desired position, or from a travelling trolley, and the normal lifting height of 10 ft. can be varied to suit customers' requirements. If desired, the hoist can be provided with two speeds so that the slower rate can be employed for precision placing, such as in the positioning and shifting of patterns and in closing moulds. Additional advantages claimed are that the light weight of the unit permits easy movement to working positions, and the incorporation of limit switches prevents overwinding.

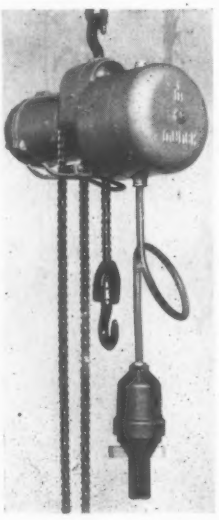


FIG. 3.—*Lightweight addition to the Munck range of hoists, marketed by Taylor Stoker Company, Limited. It is designed for lifting up to 6, or 12 cwt.*

Small Diesel Tractor

A small, wheeled, diesel tractor, only 78 in. long and 45 in. wide, yet said to be capable of moving loads of up to 15 tons over short distances, is now being manufactured by the Mercury Truck and Tractor Company, Limited, 19 London Road, Gloucester. Marketed as Model 20 ACD, it is powered by a Petter PC3 three cylinder air-cooled diesel engine, which develops 20 bhp at 3,000 rpm. Detachable steel wheels are fitted with pneumatic tyres, and 10-in. dia. Girling mechanical brakes. The tractor is fully sprung on both front and rear wheels, and can be supplied either with a windscreen or an all-steel cab.

Air-operated Hoist

The range of air-powered tools, manufactured by Ingersoll-Rand, 165, Queen Victoria Street, London, E.C.4, has been increased by the introduction of "size C" hoist. This tool is hand-operated by chain and lever in conjunction with a spring-loaded poppet-type valve which is claimed to provide positive and smooth control. The hoist can be either suspended or mounted from a four-wheeled trolley for operation from an "I" beam. Its capacity is one ton, its maximum lift 15 ft., and including the hook but not the trolley it measures about 28-in. wide by 38-in. long and weighs just over 3 cwt.

A CRAWLER-TRACK TRUCK, which enables one man to move heavy and bulky loads up or down stairways is being marketed by Chairman, Limited, 54 Holly Walk, Leamington Spa, Warwickshire. Manually operated, it is constructed of tubular steel and can handle loads up to 500 lb.

LEICESTER, LOVELL & COMPANY, LIMITED, North Baddesley, Southampton, announce that the new hardeners it has recently developed for use with Epophen epoxide resins have materially reduced the risk of dermatitis.

THE UNIVERSAL ASBESTOS MANUFACTURING COMPANY, LIMITED, Tolpits, Watford, Herts, advise that they have made two additions to the sandwich corrugated roofing they manufacture, the installation of which they claim materially reduces the bill for factory heating.

Origin of the CO_2 Process

(*Continued from p.* 517)

Oldham firm in 1920 the CO_2 process did not evoke the interest of the foundry trade at home or abroad. None of the three co-workers survived to see their forgotten invention acclaimed as one of the most important advances in modern foundry technology.

Some attempt must be made to explain why such an advantageous process lay dormant for half a century. Both Andrew Poulson and the Hargreaves Brothers were experienced salesmen of ideas, so the fact cannot be explained by any lack of business astuteness on their part. In the beginning, perhaps, their energies were distracted from the promotion of the new process by their work, in 1899, to establish the General Electrolytic Alkali Company (afterwards the Bleach and Byproducts Company); but this does not explain their failure in later years to interest the ironfounding industry.

Possibly the long hiatus was due mainly to the technological conservatism of the foundries, hesitant to introduce a novel, albeit simple, chemical procedure. Be that as it may, the first steps were taken in Czechoslovakia and the UK a few years ago to revive the process. East Germany followed and so, eventually, after the "new" process had been acclaimed in half the world, it was adopted at Widnes where it had originated more than a half-century before.

Patterns in Plastics — Methods applied at Canadian Steel Foundries (1956) Limited

The introduction of plastics in patternmaking is in some circles held to be one of the most significant developments in steel foundries for many years. Traditional materials for the highly-skilled job of patternmaking are wood and metal; wood is favoured for its ease of working and metal for the durability that enables scores of moulds to be run off one pattern. Now a third range of materials—plastics—has been added. This group combines the best properties of wood and metal and has a smoothness which produces patterns so accurate that the finished castings need practically no machining.

Prominent in the use of the new technique is Canadian Steel Foundries (1956), Limited, formerly the steel foundry division of Canadian Car Company, Limited. Long-term study and research lie behind this advance, which is mainly the work of the company's metal patternshop foreman, Mr. H. Burton. Figs. 1 to 11 and their captions give a stage-by-stage description of the method practised at Canadian Steel, which needs no further amplification.

FIG. 1.—*No matter how complex the pattern to be made, the first step is the production of removable inserts and cores. The framework in this picture is the first stage in making a corebox cover.*

FIG. 2.—*The positions of the cores and inserts are next accurately fixed, to give a firm basis.*

FIG. 3.—*The first coating of plastic is applied with a spatula to avoid forming air bubbles.*

FIG. 4.—*If the framework has to be reinforced, pieces of strapping iron can easily be added.*

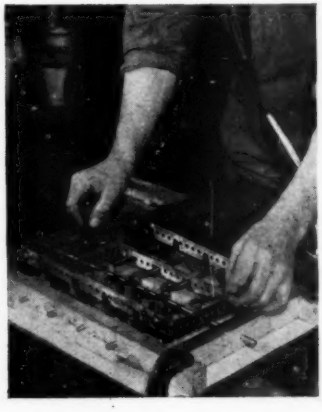


FIG. 5.—*At least two layers of fibre-glass cloth are put round the initial layer of plastic.*

FIG. 6.—*The remainder of the plastic coating is built up around glass-fibre matting.*

FIG. 7.—*This pattern will be subjected to high pressures. Iron straps are provided for further reinforcement.*

FIG. 8.—*A steel plate is clamped to the side of the box and liquid plastic is poured in to complete the pattern.*

FIG. 9.—*Here, a thin film of releasing agent, added to ease separation from the mould, is removed from the finished pattern.*

FIG. 10.—*The last pieces of releasing agent are removed from one side of the pattern and the smooth surface becomes apparent.*

FIG. 11.—*The final pattern shown at the rear needs no machining and was made at a fraction of the cost of the metal one shown in the foreground.*

Applications

Nowadays, foundries are making more and more complex castings and working to increasingly fine tolerances and this is what—in the Author's opinion—makes the use of plastics so important. The more intricate the pattern, the greater the economy of using plastics, and the greater the gain in accuracy; long runs and repeat orders benefit especially. Furthermore, easy separation of the pattern and its release from the mould cuts down mould breakage and distortions found sometimes with wood or metal patterns. Even the harshly abrasive action of sand particles has little effect on plastic patterns. Also advantageous is the lightness of plastics, particularly with large coreboxes which are inconveniently heavy if made of metal.

Abstracted from an article appearing in the *Hawker Siddeley Review.*

REDPATH, BROWN & COMPANY, LIMITED—Mr. F. C. J. Bagnall, manager of the London branch, has been appointed a director.

BRITISH OXYGEN ARO EQUIPMENT, LIMITED—Mr. R. J. Foster, general manager, has been appointed a director and general manager.

Alternative Methods of Patternmaking

By "Tramp"

Most jobs coming into a foundry can be tackled in a variety of ways; thus, it is the best policy for the patternmaker to consult the moulder before proceeding with the construction of any new pattern for castings, which differ from the general run of work. This is particularly true when the casting is of large to medium size because the box parts involved, and the number of crane lifts required, all have an important bearing on the cost of the casting.

An example of a casting that could be made by alternative methods is shown in Fig. 1. In this case, the patternmaker proceeded to construct the pattern without first consulting the foundry staff. This resulted in the supply of a pattern, split so as to be moulded in two half-boxes and requiring a core to take out the centre, as is shown in Fig. 2. Had the foundry executives been asked for their opinion before the pattern was constructed, they would have requested something entirely different—similar to that shown in Fig. 3.

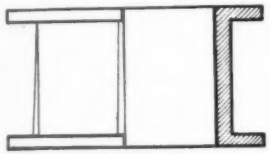


FIG. 1

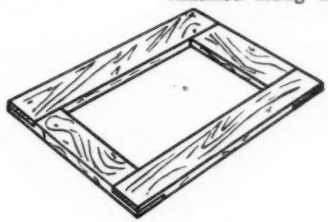


FIG 3

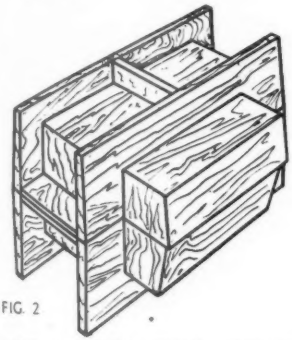
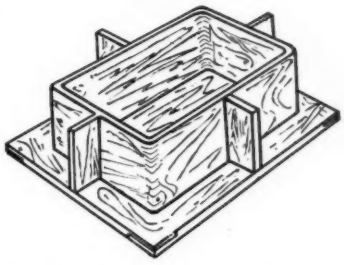


FIG. 2



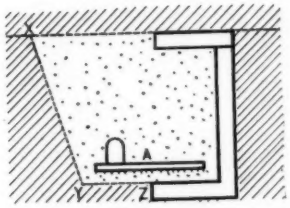


FIG 4.

FIG. 1.—*Half exterior view and half cross-section of the casting required.*

FIG. 2.—*Pattern originally supplied without prior consultation with foundry staff; this pattern necessitated the making of a heavy core, and resulted in tapered flanges on the casting.*

FIG. 3.—*Top and bottom sections of revised equipment that would make for simplified production of the casting.*

FIG. 4.—*Sketch of the method of moulding the recess under the flange and showing the location of the lifting grid.*

Reasons for Modification

Their reasons for this preference would be numerous. Considering the pattern as supplied, it required a two-part box of fairly large dimensions and an excessive amount of taper or draft on the flange portions to ensure easy withdrawal from the mould. Also, a large core was necessary to form the centre; this had to be made, dried, and assembled into the mould, and in the latter operation, there was a risk of a crush occurring on closing. Lastly, a large number of crane lifts were required during the progress of moulding and assembling by this method.

Alternative Method

With the alternative method (using the pattern shown in Fig. 3), one large flat top-box and a cast-iron grid would be all that were required to produce the mould, as it could be made quite easily in the foundry floor, the centre portion leaving its own core. The method used would be to place the pattern on a previously prepared sand bed and make a joint on the top of the lower flange as shown (XYZ) in Fig. 4. After applying parting powder to the joint, a layer of sand could be rammed along the face (YZ) and a grid (A) embedded. This part of the mould could then be finished by "bedding down" the top flange and making a joint there. With the top flange in position, the centre pod could be rammed and the top-part covering the whole, completed. To extract the pattern, after lifting off the top box, the top flange would be taken off, the portion of the mould forming the exterior core (rammed in one piece) withdrawn, and finally, the main body of the pattern extracted. After returning the exterior core portion and the top box into position, the mould could then be weighted and cast, giving a far superior job to that produced from the original pattern supplied.

Alternative Methods of Patternmaking

The main faces of the casting would be flat and parallel whereas by the first method, the taper required would necessitate excessive machining of the flanges. Another advantage of the second method would be if the mould was to be black-washed, where it was intended to cast the job in dry sand. With the first pattern, difficulty would be experienced in applying the blacking because of the deep narrow portion forming the flanges and unless exceptional care was taken to clean out any surplus black-wash, a misshapen flange would result.

AFS Convention Papers

The following abstracts are from papers presented to the 61st annual meeting of the American Foundrymen's Society held this year at Cincinnati, Ohio.

"Effect of Carbon and Manganese on Properties of Constructional Steels for Dynamic Loading Applications," by R. D. Engquist.

After a study of the failures of a number of steel castings under arduous working conditions, the Author found superior impact test results by modifying the American grade "B" steel. This he did by lowering the carbon content from 0.21 to about 0.18 and raising the manganese from 0.97 to 1.20 per cent. Over a wide range, well below zero to 80 deg. C., great improvement was shown in the impact strength. This established, the Author carried out further tests to establish how the modified steel reacted to hot tearing, and again a substantial improvement was registered. The spiral fluidity tests and the appearance of normally produced castings showed no significant difference from those made from grade "B" steel. Satisfactory results were also shown by tests made to ascertain the welding properties. This is of interest because at one time high manganese was thought to induce weld embrittlement, but now-a-days using modern methods of welding (low-hydrogen welding electrodes), this is no longer tenable. The Author claims that this 0.12 carbon, 1.20 manganese steel is better than the standard grade "B" for surface hardening areas of local wear.

"Some Observations on Galvanizing Embrittlement of Malleable Iron," by R. W. Sandelin.

The Author directly relates the appearance of embrittlement in malleable cast iron to the phosphorus and silicon content and illustrates the boundary line between occurrence and non-occurrence. He suggests a pre-treatment consisting of heating to 680 deg. C. followed by water quenching before galvanizing will eliminate the possibility of later embrittlement.

"Mould Hardness: What it Means," by R. W. Heine, E. H. King and J. S. Schumacher.

The Authors have shown there is a basic relationship of mould hardness to green strength. It would appear that if a foundry will establish curves for these two properties, then control can be effected by using the very simple mould-hardness testing apparatus.

Estimated Pig-iron Output for 1957

Total output of pig-iron for 1957 is estimated by the Iron and Steel Board to reach 14,500,000 tons—1,300,000 tons more than was produced in 1956. This expansion is being obtained with no increase in the average number of furnaces in blast—98 this year, compared with 99 in 1955 and 100 last year. The higher output is the result of the coming into operation of large new furnaces in place of old plant.

The lowest recent figure of pig-iron and blast-furnace ferro-alloys production was for the second quarter of 1955, when 3,005,000 tons was recorded. It rose to 3,408,000 tons in the first quarter of 1956, but dropped to 3,151,000 tons in the third quarter of the year. The totals for the first three quarters of 1957 are:—3,464,000 tons, 3,626,000 tons, and 3,537,000 tons.

Scrap supplies have also risen considerably this year, partly as a result of Government surplus disposals after the revision of the defence programme. Receipts of home-bought scrap at steelworks and steel foundries were at the rate of 102,000 tons a week in the first nine months of this year, compared with 94,800 tons in the corresponding period of last year. Estimated total receipts this year are 5,250,000 tons, or between 400,000 and 500,000 tons more than in 1956.

Fewer Imports of Pig-iron and Scrap

While home supplies of both pig-iron and steel-making scrap have increased substantially, the Iron and Steel Board states that requirements of pig-iron for the production of iron castings have been reduced. The output of iron castings during the first half of 1957 has been about 7 per cent. less than in the corresponding period of 1956. The total supply of pig-iron and scrap from home sources for steelmaking (including pig-iron from furnaces normally producing foundry iron) has been 11 per cent. greater than last year.

This has resulted in a cutting down of imports of pig-iron and scrap and in the building up of stocks. Imports of pig-iron and scrap this year should amount to only 1,000,000 tons, compared with 1,900,000 tons in 1955 and 1,500,000 tons in 1956. Next year they are expected to decline to less than 500,000 tons, pig-iron being limited to small balances of outstanding contracts.

Supplies of imported iron ore are satisfactory and in the third quarter of this year over 5,000,000 tons were brought in—a record figure. Stocks now amount to 2,800,000 tons. Stocks of scrap, pig-iron, and imported ore at the end of September were all substantially higher than a year ago. Stocks of imported iron ore at works and ports have risen from 1,591,700 tons in September, 1955, to 2,337,100 tons last year and 2,814,400 tons this year. Stocks of pig-iron at blast furnaces, steelworks, and steel foundries rose from 498,900 tons and 660,200 tons, to 942,700 tons, and iron and steel scrap at steelworks and steel foundries from 653,500 tons and 913,300 tons, to 1,102,400 tons.

For the first nine months of 1957 the production of crude steel is 6 per cent. above that of the corresponding period of last year. The lowest recent output figure was recorded for the third quarter of 1955—4,547,000 tons.

Predicting an all-time record for steel production in 1957, including a big expansion in western Germany and the other ECSC countries, the United Nations notes that Britain's share in world steel production has declined from 10 to 8 per cent.

Vacuum Treatment of Molten Metal*

Russian Experiments on Bessemer and Electric Steels

Whilst there seem to be immediate prospects of some improvement of steel ingots resulting from vacuum treatment of the type described in this article, the benefits may not be directly applicable to metals melted for casting into sand moulds and this distinction should be borne in mind when assessing such reports. British experience with vacuum treatment of steel on a quantity basis is already considerable, but inquiry reveals that the use of such metal for pouring ordinary castings is not yet envisaged. It is obvious that to pour vacuum-degassed metal into a green-sand mould is to invite gas pick-up, and even dry-sand moulds usually contain water of crystallization or hydrocarbons. Thus, it would seem logical that any benefication conferred on molten metal by vacuum treatment could only be preserved by pouring the metal into non-reactive moulds such as dies, ingot moulds or fired-refractory moulds of the investment type. For the latter, small-scale vacuum treatment is already practised by some concerns.

The problem of obtaining steel and its alloys with minimum gas and oxide contents, and in particular low nitrogen and hydrogen content, has been recognized for many years. In the normal production of steel, the presence of gas and non-metallic inclusions generally results in a reduction of the strength characteristics. The treatment of steel in a vacuum induction furnace will produce a low gas content, but the capacity of such a furnace is generally small, and the associated equipment is both complicated and costly.

In an attempt to solve the problem of producing a steel with a low gas content, Samarin and Novik proposed, in 1940, a method of production of steel under vacuum conditions, with industrial capacities. Basically, they suggested that liquid steel should be subjected to a vacuum for a given period, the steel being contained in ladles within large vacuum furnaces. Laboratory tests showed that in order to obtain the required degassing of metals, an excessively high vacuum was not required, *e.g.* a final pressure of some 10-30 mm. mercury was sufficiently low. Fig. 1 shows the relation between carbon content and pressure; for a pressure of 76 mm. mercury the content is reduced some 10 times, for 10 mm. mercury some 76 times, and for 1 mm. mercury some 760 times.

The vacuum process therefore permits the continuous removal of non-metallic inclusions from the steel, and the application of this method to industry was carried out jointly by the Metallurgical Institute and the Enakiev works, and later by the Dneprospetstal works.

Plant for Vacuum Treatment

The main problem for the industrial vacuum treatment of metals lies in the construction of suitable plant; it must necessarily be simple and must permit the quick introduction of the ladle containing the molten metal into the vacuum chamber. Figs. 2 and 3 show details of construction of the vacuum treatment plant at the Dneprospetstal works and at the Enakiev works.

The first application of the early proposals was made in 1952-53, at the Enakiev Works, which was mainly equipped for the production of Bessemer steel. Ladle capacities of 16 tons were available, with ingot weights of 4 tons; in addition, the Elektrostal Works was developed, with a furnace capacity of some 150 kilograms.

With a vacuum corresponding to a pressure of 200-300 mm. mercury, the metal in the ladle or in the mould boils, and, with a further reduction of pressure to 70-100 mm. mercury, the boiling is intensified. At these low pressures the surface agitation in boiling may cause the molten metal to flow over the rim of the container, so that a limiting factor is the depth of the molten metal below the top of the ladle; an initial depth of some 200-250 mm. (8-10 in.) below the top gives satisfactory boiling at pressures of 75-140 mm. mercury. With this limitation, therefore, the steel was maintained under a vacuum in the ladle for 12-14 min., and in the mould for 25-30 min.

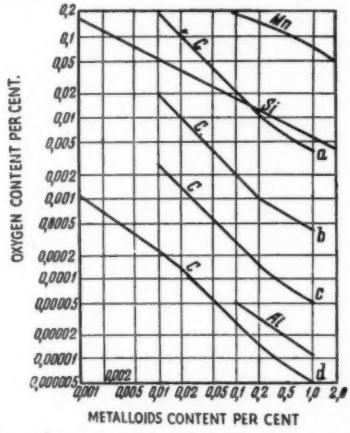


FIG. 1.—*Removal of metalloids from steel under reduced pressure.*

(*a*) Carbon at 760 mm. Hg. (*b*) Carbon at 76 mm. Hg.
(*c*) Carbon at 10 mm. Hg. (*d*) Carbon at 1 mm. Hg.

After the vacuum treatment, the metal was cast into four-ton ingots and allowed to cool; studies were then made of the segregation of sulphur, etc., the chemical uniformity, the mechanical properties, oxygen and nitrogen content, etc. Samples were

* Abstracted from a contribution by A. M. Samarin, L. M. Novik, N. I. Gorcharenka and A. F. Tregubenko to the Russian periodical *Stal.*

taken from the top, central region and bottom of ingots, and longitudinal sections made of selected ingots.

Composition and Segregation

In the melting of Bessemer steel, the vacuum treatment reduces the oxygen content by some 4 to 10 times, with a resulting concentration of 0.0044 to 0.0053 per cent. Analyses have shown that the oxygen content in vacuum treated steel is 2.5 to 5 times smaller than in non-vacuum treated steel, but that the nitrogen content is only reduced by 30-50 per cent., and still remains comparatively high. A further reduction in the concentration of nitrogen may be obtained if the intensity of boiling is not limited, but for this purpose the level of the metal must be 500-700 mm. below the level of the rim, and the vacuum pump must be capable of lowering the pressure to 10-30 mm. mercury.

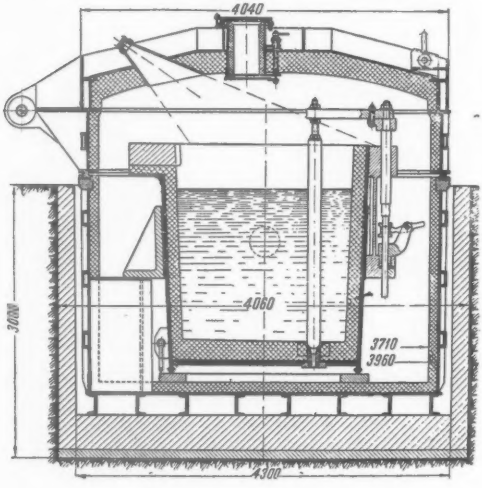


FIG. 2.—*Sketch of vacuum plant at Dneprospetstal works for the post-melting treatment of steel.*

The uniformity of distribution of the chemical contents of a steel ingot is most easily studied by sectioning. Some 47 samples were taken from a sectional 4-ton ingot. Analysis showed that there was an increased carbon content on the axis of the specimen in three places, and at two positions near the head of the ingot. There was also an increased sulphur and phosphorus content at two points, which may be explained by the contamination of the metal by coal dust. There was a variation in the oxygen content across the width and height of the ingot; in the outer layers it varied from 0.0055 to 0.0069 per cent., but on the axis of the ingot from 0.0037 to 0.0055 per cent.; this is sufficient evidence, however, of the freedom of the steel from oxide inclusions, and, in general, the steel produced had a uniform chemical composition and small segregation, which was confirmed by a sulphur print.

Mechanical Properties

A characteristic of Bessemer steel is its low impact strength at temperatures below zero, and its propensity to ageing effects. To examine the effects of vacuum treatment on the mechanical and welding properties of Bessemer steel Mark BSt3, the metal was processed in the 150kg. furnace for 20-40 minutes, and the impact strength at various temperatures down to −60 deg. C. determined. It was found that only one ingot of metal gave a threshold of cold brittleness, *i.e.*, a drastic reduction in impact strength, at −60 deg. C.; the remaining three showed an impact strength at this temperature of between 8 and 15 kg. per sq. cm. In

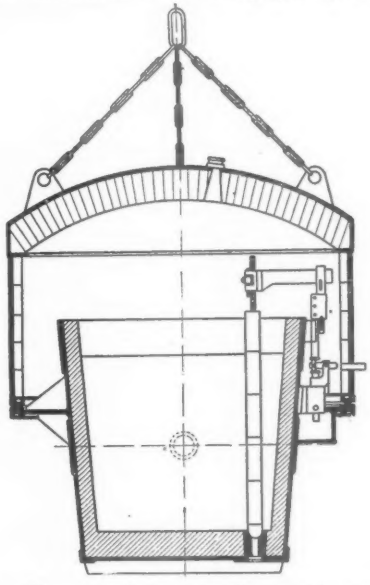


FIG. 3.—*Vacuum plant at Enakiev works used for early experiments; ladles of 16-tons capacity were employed.*

none of the steels was there a sign of ageing at temperatures down to −20 deg. C. Tests on welded specimens indicated that welded seams have a high impact and general mechanical strength in the region −40 deg. C. to −60 deg. C. Bessemer steel, worked under vacuum and then cast into moulds has a high impact strength at normal temperatures, ranging from 12 to 30 kg. per sq. cm.

In the case of specimens of material vacuum treated in the ladle, the threshold of cold brittleness was at about −30 deg. C. for four specimens out of six and about −50 deg. C. for the others. Out of four specimens vacuum treated in the mould, one had a limit of cold brittleness at 0 deg. C. one at −20 deg. C., one under −20 deg. C., and the final one under −30 deg. C.

For open-hearth steel of the same analysis, the cold brittleness limit is −20 deg. C.

Treatment of Electric-melted Steel

The first industrial application of the vacuum process was made at the Enakiev Works in June-August, 1955, when two furnaces were erected, each of 25 tons capacity; they were completed in September, 1955. Similar furnaces are in course of erection at six other steelworks. At this time, suitable vacuum pumps were not available, so that smaller pumps were installed temporarily to allow the processing of transformer and constructional steel to proceed, with a view to the replacement of these pumps as soon as the standard type become available. The vacuum treatment period is about 10 minutes, with a pressure of 60-70 mm. mercury, achieved in from 5 to 7 minutes from the initial starting of the pumps. With these conditions, transformer and ball-bearing steel is agitated through some 300-400 mm., but the boiling effect is weaker for chrome nickel constructional steel. Supplementary pumping power was introduced in December, 1955, with a reduction of pressure to 30-35 mm. mercury. From September, 1955, the Dneprospetstal Works has vacuum-treated all transformer steel, and from January, 1956, all chrome nickel constructional steel.

Transformer steel is quite likely to be overheated, and the vacuum process is particularly useful in reducing the carbon content to 0.01 per cent. Results of trials with the vacuum process indicate that, for transformer steel, the carbon content is not greater than 0.02 per cent. and the sulphur content 0.003 to 0.005 per cent. Such a reduction would not be possible by any other means. When the plant was initially started (September, 1955), a carbon content of not greater than 0.02 per cent. was achieved for only about 13 per cent. of the total output, with a sulphur content of 0.004 to 0.005 per cent. in only 18 per cent. In the second period, however, from December, 1955, the quality has considerably improved, due to the increased vacuum. The reduction of carbon, sulphur, oxygen and hydrogen content in transformer steel reduces the watt-losses considerably.

For non-vacuum treated steel, the output of steel with a P_{15} watt-loss of 2.1 watts/kg. comprised 25 per cent. of the total, and with a loss of 2.0 watts/kg. only 2 per cent. of the total. For P_{10}, the figure for 0.9 watts/kg. is 6 per cent. On the other hand, with vacuum-treated steel the output of steel for P_{15}, not greater than 2.1 watts/kg., has been raised to 92 per cent. of the total, and not greater than 2.0 watts/kg. to 67 per cent. For P_{10}, with losses not above 0.9 to 0.95 watts/kg. the figure is 50 per cent. For sheet 0.35 mm. thick, the watt-loss for P_{15} is 1.43 to 1.63 watts/kg., and for P_{10}, 0.66 to 0.75 watts/kg.

These results indicate the importance of the vacuum process when applied to transformer steels, and it has been decided that all transformer steel will, in future, be similarly treated.

The vacuum treatment of chrome nickel steel was only begun in January, 1956, but the effect of the process in reducing the number of hair-line cracks in the macrostructure has been noticed. In the first quarter of 1956, a number of different types of chrome nickel steels were experimented with, and it was found that, with vacuum-treated specimens, 42 per cent. were completely free from hairline cracks, while with non-treated specimens the corresponding figure was only 12 per cent. A considerable improvement in the quality is thus obtained, and it is expected that, with higher pumping power and an increased vacuum, the majority of ingots will be crack free.

Currently, work is in progress on the vacuum treatment of heat-resistant alloy steels.

Metals at Low Temperatures

Flow and Fracture Properties

Low-temperature research is providing much valuable information regarding flow and fracture properties of metals. It has been found, for example, that at extremely low temperatures only metals with a body-centred-cubic atomic structure show a strong dependence of yield strength upon temperature, states E. T. Wessel, in a paper read at the 38th annual convention of the American Society for Metals and referred to in a recent issue of *Materials and Methods*. However, the yield strength of these metals does not increase as rapidly at the lower temperatures as predicted by current theories of the temperature dependence of yield strength. Quenched and tempered steels and beta-brass exhibit considerable plastic deformation at −232 deg. C. The author further points out that the face-centred-cubic metal, nickel, and the close-packed-hexagonal metal, zirconium, show only slight dependence of yield strength upon temperature. The lack of any temperature dependence of yield strength at the lower temperatures is considerably more pronounced in these metals than it is in the body-centred-cubic metals, the yield remaining constant below −115 deg. C.

It is also pointed out that the work-hardening characteristics of the various materials as related to test temperature may be divided into two categories: the face-centred-cubic and close-packed-hexagonal metals show a decided increase in capacity for work-hardening at low temperatures, whereas the body-centred-cubic metals show a decided decrease in ability to work-harden. During the investigations, it was observed by the author that quenched and tempered alloy steel do not show the usual large percentage increase of yield strength with decreased test temperature characteristic of the body-centred-cubic metals. He considers that this behaviour is due to an initial high room-temperature yield-strength resulting from carbide particle size, shape and distribution, and proposes a relationship which provides a simple method of approximating the temperature dependence of the yield strength of alloy steels.

Mr. W. J. RUSTON, chairman of Ruston & Hornsby, Limited, engineers, Lincoln, presented a long-service medal, a certificate and gold watch to five men who have been employed by the firm for 50 years.

Book Review

Typical Microstructures of Cast Metals, edited by G. Lambert. Published by the Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, 3; price 84s. (members, 21s.).

This book, the first ever to cover so wide a field, is the result of many years of committee work and is unquestionably a work of the highest quality and of utmost value to the technology of the industry. The opening section covers in a dozen pages the not-too-easy task of the proper preparation of specimens for microscopic examination; here, also, reliable information is given as to etching media for the various alloys dealt with. In the three following main sections, cast irons (79 pages), steels (50 pages), and non-ferrous alloys (69 pages) are examined in turn, the whole embodying the reproduction in excellent quality of nearly 300 photomicrographs. Finally, there is a comprehensive index.

Any engineer having but a limited knowledge of metallurgy, studying the section covering cast iron, must be impressed with the fact that this is not a single material but a very wide variety of alloys having equally diverse properties. For this alloy, in the earlier pages, many etched and unetched examples are shown at various magnifications, and throughout the book these are related to chemical composition and mechanical properties. This method of treatment is well developed for the specified grades of cast iron, although differences in the qualities of iron are sometimes better shown by the etched rather than the unetched specimens. Perhaps there should have been indicated somewhere, from just what thickness of specimens the photomicrographs of cast iron were taken.

For the steel-castings section, it is definitely stated that the micro-sections were all obtained from test-bars cast 1½-in. thick—a very useful piece of information. The structures of the specimens are rightly shown in the as-cast state and also after being subjected to heat-treatment. A wide range of alloys is included, from plain carbon steel to stainless.

Mainly because it is the only section of the book so treated, it is rather hard luck on non-ferrous founders that examples of defects should have been included in such a book of "*Typical* Microstructures"—especially as works of reference exist covering defects in castings (though not necessarily, of course, the microstructures associated with them). However, the inclusion of these few defect micrographs will help founders to identify contaminants, faults in alloying, heat-treatment, etc., and the reviewer knows of no better way of doing this. The inclusion of a number of macrographs in the non-ferrous section is deemed to be wise, as they do graphically show how effective grain refinement can be.

The book can be unreservedly recommended to all those whose work in life is to control the manufacture of cast products. Here are available standards to which each foundry's production can be compared. A match between one's own "micro" and the reference structure recorded in this book for the same alloy will denote that a good basic structure is being produced in the foundry, and never has that been possible before from a single book for such a great number of cast metals.

V. C. FAULKNER.

ENGLISH ELECTRIC COMPANY OF AUSTRALIA PROPRIETARY, LIMITED—Mr. Cyril W. Goodman, formerly general manager in Australia of the English Electric Company, Limited, has been appointed chairman and managing director of the company, which has been formed with an authorized capital of £A3,000,000.

New Catalogues

Specialized Castings. Lloyds (Burton) Limited, Burton-on-Trent, have prepared six leaflets covering their specialized foundry productions. The layout used for most of these four-page leaflets is to use a typical casting for illustrating the front cover; to employ the next page for technicalities; the third for illustrating a range of castings produced in the alloys described; whilst the back page has been put to diverse uses in the different leaflets. Three of the leaflets cover applications of "Thermalloy," a heat-resisting steel; the fourth deals with manganese steel; the fifth is devoted to summarizing the properties of the various alloys Lloyd's manufacture, and the sixth is confined to ductile iron. The reviewer commends the wisdom shown in producing leaflets showing separately what a foundry does in several different fields, as with catalogues showing a greatly diversified production, but little interest may be contained for an engineering buyer operating in quite a narrow field.

Die Castings. Fry's Diecastings, Limited, Midland Works, Brierley Hill Road, Wordsley, Stourbridge, in a new publication have hit upon the interesting theme "Your Questions Answered." Thus the heading to each major section carries a question mark, and by this means, the potentialities of die-castings are set out. The illustrations chosen are as convincing as the letterpress; page 6, for example, carries a picture of a 7-in. high gravity-die-casting of considerable complexity carried out in a silicon/aluminium alloy. A feature of this publication is the detailing of the wide range of non-ferrous alloys now being die cast commercially. Amongst foundry trade literature this publication ranks high, reasonable use has been made of colour, which blends with the dignified layout of the text and illustrations.

Hard Surfacing. An interesting process is disclosed in two leaflets received from Danite Hard Metals, Limited, Carr Hill, P.O. Box 9, Doncaster. One gives instructions for the depositing of metal claimed to be of a hardness of 800 Vickers diamond pyramid by electric-arc application, and the second for doing a similar job with oxy/acetylene gas. The instructions are quite clear, even to the showing of the difference in the gas flame when operating on steel and on cast iron.

Atmospheric Pollution. Publication No. 70 issued by W. C. Holmes & Company, Limited, Turnbridge, Huddersfield, describes and illustrates a system of eliminating atmospheric pollution by industrial combustible vapours and gases by catylitic combustion—a low-temperature oxidation process by which combustible vapours and gases of an organic nature are converted to odour-free gases.

Shot-blast Plant. Leaflet No. PS/2 announces the placing on the market by Vacu-Blast, Limited, 291, Aberdeen Avenue, Slough, of a new model, the "Vacu-Blast Major." This machine retains the basic principle of propelling steel grit on to flat surfaces and instantaneously withdrawing it into the machine for re-use, and occupies but 7 ft. 7 in. by 3 ft. 6 in. of floor space.

Pumps for Chemicals and Slurries. Wilkinson Rubber Linatex, Limited, Camberley, Surrey, have issued an eight-page brochure describing both hand-operated and motor-driven pumps specially designed for handling either corrosive or abrasive liquids and slurries. Both constructional details and operating data are clearly set out.

Production Aid to the "Coreshooter"

*By H. A. Wincer**

The coreshop at the Author's works serves a foundry "tied" to an engineering section which means essentially a jobbing foundry. The production runs are seldom very long, being generally of the order of 10 to 500 off, perhaps repeating in monthly or quarterly cycles. As a result of this type of production, many of the coreboxes are constructed of wood. The firm runs one basic core-sand mix, with oil and starch binders and, as most of the cores are handled "green" from the corebox to the coreplate, a core-sand which is tough in the green state is necessary.

Many of the cores, however, require reinforcing with rods or nails and also need venting. These operations slowed down the production from the firm's Coreshooter machine which was otherwise very rapid. A time lag resulted from the corebox having to be removed from the machine clamps and table, placed on a bench, and re-clamped, before the rods and vents could be inserted. To overcome this, the following modification has been made to the machine. An angle-iron runner or rail is

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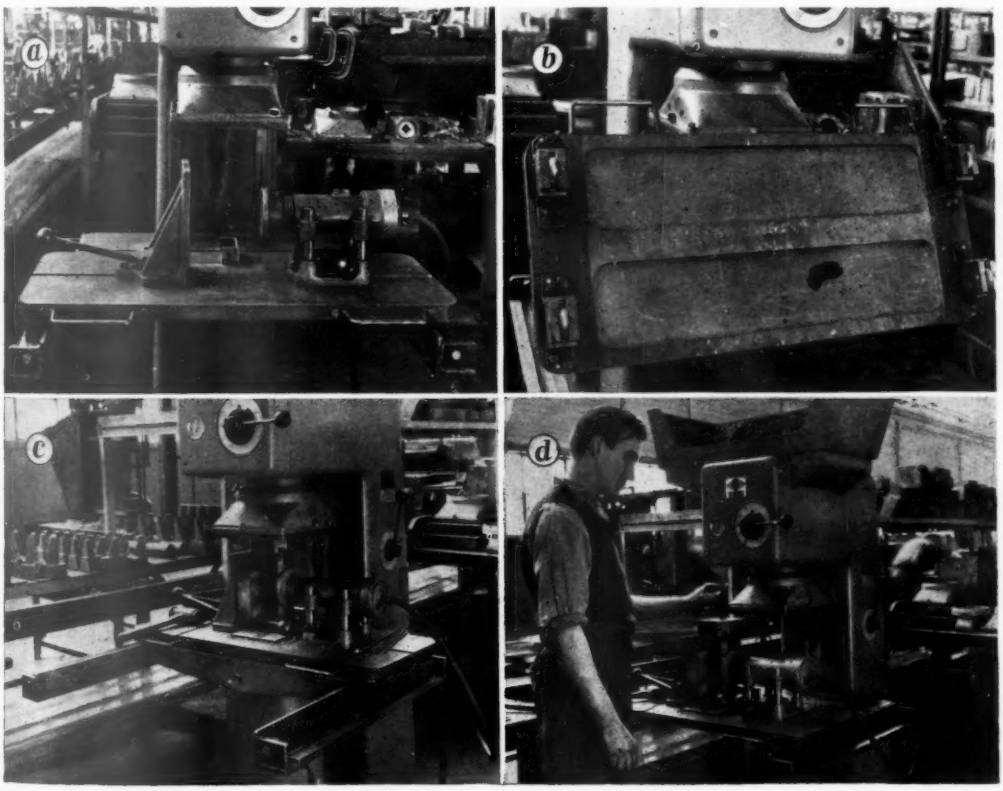
FIG. 1.—*Stages in the operation of the "Coreshooter" type of coreblower, modified by the incorporation of a false table.*

(a) False table and clamping device, running on side rails.

(b) Underside of the false table, showing the spring-loaded wheels.

(c) Table moved to the "blowing" position, at which operation of the clamping head depresses the springs so that "solid" support is afforded.

(d) Removal of the assembly permits insertion of a rod, three nails and a vent while the whole is still clamped.



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attached to each side of the machine table and running—to and from the operator—on four wheels along the rails is a false table, complete with transverse "T" slot to take the machine clamps (see Fig. 1 (*a*)). The wheels, Fig. 1 (*b*), on the underside of the false table are spring loaded.

Operation

In operation, the machine is set up in the normal way, adjusting the height of the table to allow minimum clearance between the top of the corebox and the "shooting" head (see Fig. 1 (*c*)). With the false table drawn forward, clear of the machine, the corebox is placed between the clamps and against the back stop. The control lever is moved to "clamp" and the false table is then moved forward under the shooting head. On moving the control to "up," the machine table rises and the springs on the wheels of the false table are compressed so that the machine table and the false table are in complete and solid contact. The core is next "shot." The control is returned to "clamp" which releases the false table from the machine, allowing it to be withdrawn forward along the rails, clear of the shooting head, with the filled corebox still held securely in the clamps. With the box clear of the head, the rods, vents, etc., can be easily inserted as shown in Fig. 1 (*d*). Finally, the control is set to "stop" and this releases the clamps, allowing the corebox to be taken from the table and the core to be removed.

The saving made by this addition to the machine is naturally greatest where further work is required on the core after shooting. With the core shown in the illustrations—in which a rod, three nails and a vent have to be inserted—a time saving of 40 per cent. has been obtained as compared with the previous method involving shooting and re-clamping on a separate bench.

If incorporated as part of the machine as supplied, which seems to the Author a fairly simple matter, the sliding table could be operated by an air cylinder, controlled by arranging a further station on the control valve between "clamp" and "up." This would eliminate the necessity of the operator moving the table manually and could be so interlocked to prevent the machine being operated in the wrong sequence.

Scottish Claims for New Strip Mill

New economic facts concerning the location of the steel strip mill which is planned by Richard Thomas & Baldwins, Limited, are to be submitted as a matter of urgency by the Scottish Council (Development and Industry) to the Government. Lord Polwarth, chairman of the Council, said he believed its arguments could be sufficiently compelling "to tip the balance in Scotland's favour."

"We felt our claims must be supported as far as possible with sound economic facts," Lord Polwarth said. "For the past two months our staff have been working hard on technical points dealing with costs. These appear to us to be a good deal more favourable to Scotland than is generally believed."

Probably with more time an even stronger case could be prepared, but the possibility of an early decision by the Government on the site for the mill made it necessary for the council to convey its views to the Secretary of State without delay.

Basic Material Prices Down

Raw materials used in every section of industry were cheaper in September and the index of wholesale prices dropped to its lowest point since June, 1955. Since the beginning of this year, when basic material prices were at their peak, there has been a fall of a little over 6 per cent.

Last month material prices fell by nearly 2 per cent., while manufactured goods prices rose by 0.1 per cent. Many commodities shared in the decline. Copper prices were down 6.9 per cent., raw rubber 6.4 per cent., linseed oil 5.9 per cent., lead 2.3 per cent., whale oil 7.7 per cent., and sulphur 5.4 per cent.

The index number for materials used in the mechanical engineering and electrical machinery industries fell by 0.3 per cent. and 1.3 per cent., respectively. The index for fuel used in manufacturing industry rose by 0.3 per cent.

Head Wrightson Reactor for Germany

Co-operation in the design and engineering of an atomic materials testing reactor has been arranged between Head Wrightson Processes, Limited, and the German concern, Land-Nordrhein-Westfalen, which wishes to benefit from the experience gained by Head Wrightson Processes in the atomic reactor field.

The reactor which the British company is to supply to Germany is a high flux testing reactor similar to the "Dido" and "Hifar" reactors which it has provided for the United Kingdom Atomic Energy Authority at Harwell and the Australian Atomic Energy Commission at Lucas Heights, Sydney.

This is the sixth reactor order awarded to the Head Wrightson group, and the third for export. In addition to the Australian project the company recently announced an order for a research reactor for Denmark.

Canadian Iron-ore for Germany

Plans for turning Northern Quebec's large low-grade iron-ore deposits into a principal source of supply for west-German steel mills are taking definite shape. American and Canadian interests have teamed up with five of the largest steel companies of west Germany to form Ungava Iron Ores Company to mine and ship the ore. Ownership is split on a 50/50 basis between the two groups. Ore deliveries are expected to begin in 1961, when production is expected to amount to 500,000 tons of iron-ore pellets. By 1963, this figure is expected to reach two million tons, and by 1965, five million tons.

Participants in the project include Cyrus Eaton, the Cleveland financier who holds mining concessions in the Ungava Bay region, and Alfred Krupp, the German steelmaker. Present plans call for direct shipment of the ore from Ungava to Rotterdam.

ITALIAN INTERESTS are to erect a £250,000 steel rolling mill at Bulawayo, Southern Rhodesia. Maximum production will amount to 10,000 tons of steel a year. Technicians will be brought from Italy.

Notes from the Branches

South Africa

The presentation of a paper entitled "Epoxy Resins for Patternmaking," by Mr. M. van der Wende, Mr. D. Jepson, and Mr. K. H. Coombs, attracted a near-capacity audience to the National Cash Auditorium (seating 120), Johannesburg, when the South African branch of the Institute of British Foundrymen held its monthly meeting. The president, Mr. S. Piennar, was in the chair.

The Authors commenced by saying that there were available in South Africa three types of epoxy resins having viscosities referred to as high, medium and low, and when using these it was essential that the recommended amount of curing agent be adhered to, regardless of the quantity mixed, otherwise the physical and chemical properties of the end-product would be adversely affected. When during the summer in South Africa day temperatures reached the 80's, foaming was likely to become a serious problem when fast curing agents were used. To overcome this, the Authors recommended that a slower curing agent be used and precautions taken to keep the resin cool by immersing the container in a bowl of cold water. With regard to fillers, it had been found that hard materials such as silica-flour tended to make the cured resin brittle and prone to crazing, to counteract this tendency the addition of 3 to 7 per cent. of a toughening agent was recommended.

Process Details

To avoid loss of time in the drying of plaster of Paris moulds, the Authors had developed the following method of sealing the damp-plaster mould-face so that it became impervious to moisture: Two coats of shellac may be applied to the mould cavity, each coating being afterwards lightly rubbed with a very fine sand-paper to maintain a smooth surface finish. When the second coating has dried completely the cavity should be sprayed with an epoxy-resin varnish, care being taken to cover the surfaces of all recesses and pockets. The mould may then be left to dry off and for the resin film to fully cure and harden. It was pointed out that, unlike sprayed enamel coats on damp plaster-moulds, epoxy-resin films did not flake off; this was due to the excellent adhesive properties of the resin. Any failures could be traced to uneven coating. Epoxy-resin varnishes were now manufactured locally (in South Africa) and had proved to be very successful for this purpose.

Economy Measures

The Authors went on to say that epoxy resins were expensive materials, and where the pattern to be made was bulky or had a large volume with a small surface area, a marked saving in material costs could be achieved by forming the interior of the pattern with a core of wood, metal, polyester or epoxy resin, expanded with a large percentage of filler. Citing a case of repair to a worn pattern, where the pattern-plate required to have a print built up to the original dimensions, the Authors said that this was accomplished by laying two strips of cloth around the print cemented with epoxy resin, and within two hours the plate was back in service. A fact of value to pattern-makers was that epoxy resins would join almost any two materials together, *i.e.* glass to metal, metal to metal, wood to metal, etc.

In conclusion, the Authors gave a warning that some curing agents were known to cause a dermatitis condition in some people prone to that sort of skin affliction, and precautions should be taken to avoid contact with the skin and to prevent fumes from entering the eyes; if contact did occur the area should be washed with a copious supply of water. A lively discussion was opened by Mr. N. Sutherland and concluded with a hearty vote of thanks to the Authors by Mr. H. Estler.

Australia (Victoria)

The September meeting of the Australia (Victoria) branch of the Institute of British Foundrymen, was given over to hearing a paper from Mr. P. W. Goad, of the Commonwealth Scientific and Industrial Research Organization, which he entitled "How Temperature Affects Moulding Sands." The lecture, which dealt with fundamentals affecting behaviour of sands at high temperature and with techniques employed to develop moulding sands with optimum properties for given applications, was illustrated with coloured slides. As usual the meeting was followed by a light supper.

New Patents

(Copies of complete specifications are obtainable from the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s. 6d.)

779,723. Goetzewerke Friedrich Goetze A.G., Burscheid, near Cologne, Germany.

Apparatus for casting metals, particularly iron, under pressure, which it is claimed eliminates the disadvantages of known systems. For example, the fact that the outlet provided in the bottom of the pouring crucible can be opened and closed only with the aid of mechanical means, *e.g.*, a stopper on a rod; also the fact that the container holding the metal has only one outlet.

779,797. Joze Germek, 11, Ulica Heroja Jevtica, Maribor, Yugoslavia.

Multi-part die-cast articles and moulds for them. The invention deals especially with the method as applied to the manufacture of hinges.

780,004. N. S. Ashton, Limited, St. Andrew's Road, Huddersfield, Yorks.

A copper/aluminium alloy, which, by virtue of its precipitation-hardening characteristics is capable of providing articles having high resistance to creep at temperatures up to and including 500 deg. C. It also has good mechanical properties at ordinary temperatures.

780,007. William Jessop & Sons, Limited, Brightside Works, Sheffield.

Heat-resisting alloys of the kind having a cobalt/iron/chromium base.

780,039. Foundry Services, Limited, Long Acre, Nechells, Birmingham, 7.

Improvements in the formation of moulds and cores by the process which consists of blowing sand into a mould or corebox by air pressure. According to this invention, a mixture of sand and a gas-hardenable binder is blown into a mould or corebox. A gaseous hardening agent is applied thereto as the mixture is entering the mould or corebox.

780,115. Union Carbide, Limited, Grange Mill Lane, Wincobank, Sheffield, Yorks.

A process for malleablizing iron and an alloy for effecting this. The alloy, a ferro-silicon, is one which can be put through the cupola without subsequently treating the iron with costlier ferro-boron alloy. The invention also has for its objective the simplification of the production of consistently-high-quality malleable irons of both the ferritic and pearlitic-grades.

Company News

JOHN I. THORNYCROFT & COMPANY, LIMITED, engineers, ship builders and repairers, etc., of London, S.W.1—Group trading profits recovered from £660,348 to £826,760. The 1954-55 figure was £1,002,709. The dividend on the £1,500,000 ordinary capital is maintained at 12½ per cent., less tax, with a final of 9 (7½) per cent.

MONSANTO CHEMICALS, LIMITED—Applications for the £3,000,000 6 per cent. debenture stock at 95, total over £7,000,000. Preference and ordinary holders applying on pink forms, to whom special consideration was promised receive full allotment up to, and about 50 per cent. above £1,000. Applications on white forms will be met in full up to £200 and about 25 per cent. above.

DAVY & UNITED ENGINEERING COMPANY, LIMITED—The proposed rights issue which the company intended to make later this year will not now be made. According to Mr. D. F. Campbell, chairman, the directors have decided to defer the proposed issue and are examining alternative methods of finance. The decision was taken in view of the changed circumstances caused by the increase in the Bank rate.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained. Details of tenders with the reference ESB can be obtained from the Board of Trade Export Services Branch, Lacon House, Theobalds Road, London, W.C.1 (telephone: CHAncery 4411, ext. 738 or 771), unless otherwise stated.

HILLSBOROUGH, DOWN, November 11—Distributing and laying of the following approximate lengths of spun-iron pipes, together with all ancillary works, for Rural District Council: 10,600 lin. yd. of 24 in. dia.; 3,800 lin. yd. of 15 in. dia.; 800 lin. yd. of 7 in. diameter; 1,900 lin. yd. of 6 in. dia., and 200 lin. yd. of 4 in. dia. Documents from William Barklie Maxwell, consulting engineer, 5, University Terrace, Belfast. Deposit £5 5s., cheques payable to Council.

MALDON, ESSEX, November 5—Resurfacing of 722 sq. yd. tarmacadam carriageway, construction of 1,012 sq. yd. reinforced concrete carriageway, laying of 164 lin. yd. 6 in. and 9 in. surface water sewer, 208 lin. yd. 9 in. foul water sewers, together with manholes and all other incidental and ancillary works, at Lawlinge Road housing site, Latchingdon, for Rural District Council. Documents from the Engineer and Surveyor, Council Offices, Wantz Road, Maldon. Deposit £2. Tenders by November 5.

OMAGH, TYRON, November 8—Supplying, laying and jointing of sewers, Contract No. 1, for Urban District Council. This contract covers approximately 74 lin. yd. of 24 in. dia., 144 lin. yd. of 21 in. dia., 208 lin. yd. of 18 in. dia., 325 lin. yd. of 12 in. dia., 146 lin. yd. of 9 in., and 212 lin. yd. of 6 in. dia. Pipes, together with 235 lin. yd. of 3 ft. square reinforced concrete, culvert, and all necessary manholes. Documents from the Town Clerk, Town Hall, Omagh, or from Ferguson and McIlveen, consulting engineers, 15, College Gardens, Belfast. Deposit £5 5s.

RENFREWSHIRE, November 15—County Council invite applications from machinery suppliers who wish to be considered for inclusion in a list of firms to be selected to tender for the supply of all machinery and equipment required for the new Trades School, Paisley, now nearing completion. The contract value is estimated at £40,000-£50,000. Schedules have been prepared which include apparatus and equipment for workshops for electrical and mechanical engineering, automobile engineering, and other similar trades. Applications should be made to R. Urquhart, P.O. Box No. 12, Paisley.

SOUTH AFRICA, November 29—Airless shot-blast machine with monorail conveyor and touch-up room; additional equipment such as spare blades for the shot impellors. Copy of documents and specifications available for loan to United Kingdom firms on receipt of application. (ESB/25138/57.)

Law Cases

Inducement for Weekend Work

A firm, which during the past five years paid out £4,742 in wages to employees and failed to disclose payments in Inland Revenue returns, was fined a total of £150 at Stirling Sheriff Court. The defendant company was Alex. Couper & Company, Limited, general ironfounders, of Denny (Stirlingshire), which admitted that, between April 17, 1952, and April 30 this year, false employer's "pay-as-you-earn" annual returns were made, and that they failed to disclose payments in respect of salaries and wages.

The fiscal said the company employed about 50 workers, and during the years mentioned in the charges incorrect returns had been made regarding payments to people employed by it. On August 20 last year an Inland Revenue Department officer discovered that for years there had been a considerable understatement of the sums paid to workers. The amount of unpaid tax was £783 19s.

There would be a liability either on the employees or the company to make good this very substantial sum. The Inland Revenue had been very fair in arriving at the amount considered due. The returns were always made by the cashier, said the fiscal, but one of the partners, it seemed, paid the men in respect of weekend work without any deduction of tax. This was a very big inducement to get people to work at weekends.

An agent for the firm stressed there was no question of perjury. It was purely a technical offence. There was no question of any fraud whereby the firm had derived any benefit. It was prepared to pay the tax and there had been no withholding of any information.

Maintenance Fitter Trapped

The death of a 63-year-old maintenance fitter, who was trapped between a pulley and belt of an underground conveyor at the works of William Mills, Limited, Friar Park Road, Wednesbury, on July 22, resulted in the company being fined £30 for not adequately fencing a dangerous part of a machine. Mr. W. E. J. Greville, factory inspector, prosecuting, said that in the semi-mechanized foundry, after the moulding boxes were knocked out, sand was shovelled through grids which were let into the surface of the foundry floor. The sand dropped on to an underground conveyor belt and was conveyed to a hopper. Mr. T. H. Livingstone, a moulder, said that he was called to the sand mill and found the fitter trapped by his arm up to the shoulder. His feet were clear of the floor; there was no heartbeat or pulse. Mr. T. Horton, maintenance fitter, told the court that sand used to stick to the roller and he was in the habit of cleaning it off with the aid of a file. It was also a job done by Arthur Henley, the man who was killed. Although the machinery was not fenced he had never known anyone involved in an accident with the pulley before. Since the accident an automatic scraper had been attached to the plant.

Mr. W. N. Davison (defending) stressed that Henley was a man of long experience who had scraped the rollers hundreds of times. He suggested that the employers could not have reasonably foreseen that the man would get into such a position. After the Stipendiary Magistrate (Mr. Kenneth Wood) announced that he found the case proved, Mr. Davison said that the company had been established since 1903 and it was their first conviction. The company were working in liaison with factory inspectors and any proposals they had to make would be met with co-operation.

News in Brief

THE MOVEMENT to decentralize the activities of the *Association Technique de Fonderie* is gathering momentum. A North-Eastern branch has been formed and one at Bordeaux is under consideration.

BOULTON & PAUL, LIMITED, structural engineers, etc., of Norwich, has put into operation a fencing erection service organization. The new service has distribution centres at Norwich, London, and Birmingham

ALBRIGHT & WILSON (MFG.), LIMITED, announce additions to their range of chemical-polishing solutions, these being under the trade names of Phosbrite 183 (for cartridge brass), and Phosbrite 184 (for gilding metals).

W. WATSON & SONS, LIMITED, 31, High Holborn, London, W.C.1, are staging from November 4 to 8 an exhibition of industrial and research microscopes at the Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham.

BRITISH ALUMINIUM COMPANY, LIMITED, announces that on October 28 the Midland branch sales office was transferred from its former address at Lansdowne House, 41 Water Street, Birmingham 3, to 109 Hagley Road, Edgbaston, Birmingham, 16.

THE NEW HEADQUARTERS of the Bradford and District Engineering Employers' Association in Claremont, Bradford, were officially opened last Wednesday by Mr. Arnold Simonett, chairman of directors of A. & H. Simonett (Engineers), Limited, textile engineers, Bradford.

AT September 17, the official index figure, which measures changes in the average level of retail prices compared with the level at January 17, 1956 (taken as 100), was 106, the same figure as at August 13. Calculated to one decimal, the September index was 106.1 compared with 106.4 for August.

APPROVAL for the construction of a new 300-ft. fitting-out quay at the Pallion yard of Short Bros., Limited, Sunderland, has been given by the River Wear Commissioners. The quay, which will be of open frontage construction and which will have new shops, will replace the existing fitting-out base.

MIDDLESBROUGH TOWN PLANNING COMMITTEE has approved plans by Whessoe, Limited, oil refinery plant and heat exchanger, etc., manufacturers, of Darlington, for the erection of a welding and erection shop and offices at Cleveland Dockyard, Middlesbrough. The premises are to be used in connection with a nuclear power project.

JACK OLDING & COMPANY, LIMITED, manufacturers of crawler tractors, etc., of Hatfield (Herts), has been appointed official dealer in the UK for Rolls-Royce diesel engines. The company was responsible for a well-known range of American engines for 14 years up to 1950, and since then has been associated with the Rolls-Royce-powered Vickers tractors.

MATERIALS HANDLING EQUIPMENT (GREAT BRITAIN), LIMITED, 7, Chesterfield Gardens, London, W.1, have been appointed sole concessionaires for the United Kingdom of the Traveloader side-operating fork-lift carriers, made by the Baker-Raulang Company of Cleveland, Ohio, USA, founded in 1888. This company is now owned by the Otis Elevator Company of New York.

TWO 47-TON GIRDERS designed and manufactured by Johnson Ireton, one of the Ronal Lyon group of companies, were recently positioned at the site of the new Paris cinema in Shaftesbury Avenue. These girders are believed to be the largest made post-war in Britain, and each is 60 ft. long, 6 ft. high and 3 ft. wide. The girders will support 1,200 tons of superstructure.

JOHN BOYD & COMPANY (ENGINEERS), LIMITED, Annan, Dumfriesshire, have received an order from British Railways for the supply, delivery and erection of one 200-tons carrying capacity engine traverser for their locomotive works at Crewe. The traverser will be 90 ft. long and it will be the largest apparatus of its type in Britain. It will be self-propelled through an electro-hydraulic drive to ensure smooth operation.

AWARDS WORTH NEARLY £400 were distributed among 140 young employees of the Staveley Iron & Chemical Company, Limited, Chesterfield, and its associate, Sheepbridge Engineering, Limited, Chesterfield, last week by the chairman and managing director, Mr. S. W. Martin. Guest speaker at the function was Dr. J. W. Jenkin, a past-president of the Institution of Metallurgists, and director of technical information of Tube Investments, Limited.

ROLLS-ROYCE, LIMITED, are to take over the Crewe factory of Kelvinator, Limited, for the production of items concerned with transmission and aero-engine components. The factory covers 230,000 sq. ft. and Kelvinator, which employs 844 people there, are transferring to a new factory nearing completion at Bromborough, near Liverpool. Some of the workers are going there and others will be given preference by Rolls-Royce in recruitment.

THE MOST NOTICEABLE EFFECT in the employment of Sheffield youth in the period May 9 to September 11 was the tendency to harden the vacancy position for apprentices, states the Youth Employment Officer to Sheffield Education Committee in a recent report. This was probably due to the coming cessation of national service and the necessity to examine the all-round position. It is known that employers were also giving consideration to the likely effects of the bulge years.

FOLLOWING the successful first production "Winding Journey," the Brook Film Unit have produced a further film covering the manufacture of fractional-horse-power electric motors. Two further productions, one on large motor manufacture and the other covering everyday applications of electric motors are in hand and will probably be released before the end of the year. A number of still photographs are available on request to Brook Motors, Limited, Empress Works, Huddersfield.

THE DISTRIBUTION COMMITTEE formed almost two years ago by Wolf Electric Tools, Limited, in collaboration with their main stockists has just held another successful meeting at the company's head office in London. A few weeks before the committee meets a general letter is sent to Wolf stockists inviting them to submit matters for consideration, and the number of really helpful suggestions received provides a good indication of the lively interest felt in this combined endeavour by the trade as a whole.

THE Industrial Public Relations Service of Australia have announced that the 1958 Sydney Engineering Exhibition will be held between July 14 and 19 inclusive at the Royal Agricultural Society Showgrounds, Moore Park, Sydney. The organizers have stated that 25,000 sq. ft. have already been booked and that they have added another pavilion, the "Production" pavilion to enable them to offer space for further bookings. If necessary, a second extra pavilion will be taken. Applications for space should be made as soon as possible direct to the Industrial Public Relations Service of Australia, Box 4962, G.P.O., Sydney.

Imports and Exports of Iron and Steel in September

The following tables, based on Board of Trade returns, gives figures of imports and exports of iron and steel in September. Totals for the first nine months of this year and last are also included.

Total Exports of Iron and Steel

Destination.	Month ended Sept. 30.	Nine months ended September 30.	
	1957.	1956.	1957.
	Tons.	Tons.	Tons.
Channel Islands	154	3,551	2,599
Cyprus	948	4,639	9,179
Sierra Leone	1,000	6,106	19,742
Ghana	1,348	17,955	17,760
Nigeria	1,993	41,524	41,867
Union of South Africa	7,349	50,403	84,121
Rhodesia and Nyasaland	5,090	64,233	51,702
Tanganyika	1,937	17,982	17,895
Kenya	2,316	34,651	38,562
Uganda	157	3,868	2,873
Mauritius	119	2,612	2,492
Aden	185	4,308	3,161
Bahrein, Qatar, and Trucial States	490	8,503	11,441
Kuwait	4,177	5,453	27,587
India	8,103	223,164	186,049
Pakistan	8,329	40,271	51,615
Singapore	2,685	23,123	28,864
Malaya	1,676	26,525	25,372
Ceylon	1,474	23,105	20,592
British North Borneo	138	4,558	3,070
Hongkong	3,392	47,279	63,694
Australia	10,363	154,379	145,450
New Zealand	12,419	135,694	153,010
Canada	21,472	217,912	215,103
Jamaica	1,606	17,206	17,258
Trinidad	3,101	30,435	36,174
British Guiana	598	3,901	5,736
Other Commonwealth countries	1,567	20,657	21,542
Eire	3,684	50,287	31,641
Finland	4,181	41,550	64,382
Sweden	7,809	83,376	80,941
Norway	6,242	63,630	80,860
Denmark	6,918	56,745	81,049
Western Germany	1,005	7,257	7,065
Netherlands	5,923	65,232	76,618
Belgium	3,794	24,816	35,037
France	571	6,794	13,352
Switzerland	903	10,376	13,007
Portugal	731	7,558	14,160
Spain	1,823	22,475	30,694
Italy	5,229	12,911	39 584
Austria	436	3,411	3,996
Yugoslavia	1,964	6,142	8,522
Greece	942	4,172	8,661
Turkey	1,302	2,962	5,293
Netherlands Antilles	178	6,478	2,569
Portuguese East Africa	257	2,304	3,616
Egypt	2,164	34,788	3,742
Sudan	2,273	10,923	14,829
Lebanon	2,029	4,874	10,080
Israel	117	6,425	3,263
Saudi Arabia	32	10,783	3,152
Iraq	1,250	22,971	31,607
Iran	2,834	46,581	47,461
Burma	3,180	5,810	20,643
Thailand	464	5,798	6,160
Indonesia	189	7,965	5,616
Philippine Republic	1,163	5,583	4,553
USA	3,261	41,923	38,601
Cuba	328	6,763	6,390
Colombia	584	3,170	5,124
Venezuela	11,028	50,682	88,667
Ecuador	7	3,026	2,016
Peru	659	12,168	9,491
Uruguay	240	3,477	5,637
Argentina	10,477	39,187	65,637
Other foreign countries	6,962	44,547	105,657
TOTAL	207,319	2,079,917	2,374,883

Total Imports of Iron and Steel

From	Month ended Sept. 30.	Nine months ended September 30.	
	1957.	1956.	1957.
	Tons.	Tons.	Tons.
Rhodesia and Nyasaland	508	2,685	3,834
Canada	1,502	47,633	34,142
Other Commonwealth countries and Eire	604	5,632	18,163
Soviet Union	17,298	220,804	202,947
Sweden	4,038	38,268	24,616
Norway	10,348	79,476	86,727
Western Germany	7,004	164,446	77,308
Netherlands	6,837	78,478	46,377
Belgium	10,018	293,607	117,934
Luxembourg	976	48,553	19,847
France	5,594	187,114	48,571
Italy	487	9,914	3,327
Austria	5,933	120,890	58,717
Japan	786	12,809	10,747
USA	21,512	357,302	210,127
Other foreign countries	455	57,793	25,396
TOTAL	93,900	1,725,404	988,780
Iron and steel scrap and waste, fit only for the recovery of metal	37,656	806,875	568,345

Exports of Iron and Steel by Products

Product.	Month ended Sept. 30.	Nine months ended September 30.	
	1957.	1956.	1957.
	Tons.	Tons.	Tons.
Pig-iron	12,168	90,764	96,809
Ferro-columbium (niobium)	2	122	77
Ferro-tungsten	28	813	408
Other ferro-alloys	223	3,104	2,491
Ingots, blooms, billets, slabs, sheets, and tinplate bars	12	1,282	893
Iron bars, rods, angles, shapes, and sections	61	1,552	1,419
Steel bars, rods, angles, sections, and shapes	33,559	337,363	394,672
Iron plates and sheets	7	164	402
Universal plates	643	3,079	5,149
Steel plates, ¼ in. and under ⅜ in.	373	7,184	8,998
Do., ⅜ in. and over	14,024	171,084	140,152
Blacksheets and blackplate	23,815	265,653	252,847
Hoop and strip	4,215	63,816	68,163
Tinplate	25,159	218,592	302,316
Decorated tinplate	307	4,601	3,910
Galvanized sheets	9,281	125,142	151,574
Other (including tinned sheets, terneplate, and ternesheets)	918	11,107	14,188
Railway and tramway construction material	15,130	202,163	197,610
Wire rods	3,793	29,481	43,498
Wire	6,889	70,111	81,167
Tubes, pipes, and fittings	55,674	576,677	598,364
Iron castings	272	1,605	1,494
Steel castings	164	1,345	2,073
Forgings	502	3,113	6,238
TOTAL	207,319	2,079,917	2,374,883

THE METALLURGICAL ENGINEERING COMMITTEE of the Institute of Metals is arranging an all-day informal discussion on "Fuel Efficiency in the Melting and Thermal Treatment of Metals," to be held at the College of Technology, Gosta Green, Birmingham, on February 26, 1958.

WORK HAS STARTED on the preparation of a site for the new factory of the Cincinnati Shaper Co. Inc. at East Kilbride. It is hoped to have the factory completed for production next year. The site extends to seven acres and there is room for expansion after the first group of buildings is completed.

Personal

The American Foundrymen's Society announces the appointment of Mr. RALPH E. BETTERLEY as full-time training supervisor and education director.

Miss E. HOFBAUER has resigned as secretary of Bilston Foundries, Limited, and Mr. R. A. COOPER has been appointed secretary as from November 1.

British Aluminium Company, Limited, announce that Mr. P. S. W. SWABEY is being appointed assistant general sales manager with effect from November 1.

Mr. K. J. CLARKE, assistant manager of British Thomson-Houston district office, Sheffield, has been appointed manager, following the retirement of Mr. C. A. RUSSELL.

Mr. V. L. T. HUNT, who was formerly manager of the Crown Foundry Company, Limited, Northampton, has taken up an appointment as manager of the foundry engineering division of the Ouzledale Foundry Company, Limited, Barnoldswick, Colne, Lancs.

Mr. P. M. C. WOODCOCK, manager of New Cransley Iron and Steel Company, Limited, works, Northants, which is soon to be closed, received a surprise presentation last week. He received from Mr. W. J. Hitchings, foreman of the slag plant, a chiming clock on behalf of the workers.

Mr. HUGH PRENTICE HUGHES who was works manager and technical adviser to Union Carbide Limited, alloys division, has now taken up the position of works manager with Gemec, Limited. The new £4,000,000 polyethylene plant of the latter company at Grangemouth, Scotland, is scheduled to commence operations next month.

Dr. PAUL BASTIEN, professor of metallurgy at the *Ecole Centrale des Arts et Manufactures* and a past-president of the French foundry technical association has been elevated to the grade of Officer of the Legion of Honour and Mr. GEORGES CHANDRON, professor in the Faculty of Science of Paris has been nominated Commander of the Order of the Academic Palms.

Sir FREDERICK PICKWORTH, the Master Cutler, and Lady Pickworth, have been presented with a 160-piece cabinet of cutlery to commemorate Sir Frederick's knighthood and "as a mark of esteem and affection" by directors and others connected with the English Steel Corporation, Limited. It is similar in style to that presented by the City to Sir Winston Churchill and President Eisenhower.

SIR EDWARD THOMPSON, J.P., chairman and joint managing director of John Thompson, Limited, has been elected president of the British Engineers' Association. Mr. A. I. BAKER, C.B.E., M.A., J.P., (chairman of Baker Perkins, Limited) has been elected vice-president of the Association. The retiring president, Mr. W. K. G. ALLEN, M.I.MAR.E., A.M.I.N.A. (chairman and managing director of W. H. Allen, Sons & Company, Limited) has been elected honorary treasurer.

City Casting & Metal Company, Limited, Barford Street, Birmingham, 5, announce that the following employees have received long-service awards as they have now completed 40 years of unbroken service: Mr. ERNEST BELL (aged 65), lorry driver, Mr. AH HING LAW (aged 73), band-saw operator, and Mr. BERNARD WOOD (aged 82). Amongst those at the celebration were other long-service employees, including two with 39 years' service, three with over 21 years and eight with over 10 years.

The rector and senate of Aachen Technical College have conferred the honorary degree of doctor of engineering (Dr.-Ing. E.h.) on the chairman of August Thyssen-Hütte A.G., Duisburg-Hamborn, Mr. HANS-GUNTHER SOHL, who is also chairman of the (German) Iron and Steel Board. This honour recognizes Mr. Sohl's successful engineering activities, particularly in the reconstruction and development of August Thyssen-Hütte to a high level of productivity.

At a meeting of the Council of Ironfoundry Associations on October 17, two retiring members of the Council received presentations from their colleagues in recognition of their long service to the Council and the industry. They were Mr. J. E. BENNETT, chairman and managing director of Crane Limited, and Mr. G. D. CUNNINGHAM, chairman and managing director of the Anderston Foundry Company, Limited. Both have been closely associated with organization in the industry since the formation of the Council in 1941, and Mr. Bennett has served also as one of the Council's ironfounding representatives on the Executive Committee of the Joint Iron Council.

The Council of the Institution of Metallurgists announces that Dr. A. D. MERRIMAN, G.C., M.A., M.ED., C.I.MECH.E., F.R.S.E., who has been registrar-secretary for the past 10 years will retire on December 31, next. During Dr. Merriman's tenure of office the Institution has grown from a membership of less than 1,600 to more than 3,500 and in a recent appreciation of his services by Professor F. C. Thompson (Manchester University), a past-president, tribute was paid to his part in firmly establishing the Institution as the professional organization of metallurgists. Dr. Merriman will be succeeded on January 1 next by Mr. R. G. S. LUDLAM, B.A., who has been assistant registrar in the University of Leeds since 1951.

Obituary

Mr. GEORGE SCOTT CROMAR, C.B.E., who has died in Glasgow, was a director of Barclay, Curle & Company, Limited, shipbuilders and engineers, Glasgow, and was for many years general manager of their shiprepairing establishments.

Former president of the International Nickel Company of Canada, Limited, Dr. PAUL DYER MERICA, died in New York on October 20. He was 68. From 1914 to 1919 he was associated with the metallurgical division of the US Bureau of Standards and carried out considerable research on duralumin and other aluminium alloys, developing his theory of the precipitation hardening of metals and alloys. He had been as closely associated with the research side of Inco as with its executive affairs, in the US, Canada, and the UK, and had evolved numerous iron-nickel and copper-nickel alloys. His association with the company dated from 1919, when he was appointed director of research, until 1954, when he retired from the presidency, a position he had held for two years, but he continued to serve the company on important projects and as consultant. He remained a director of Inco and its US subsidiary, the International Nickel Company, Inc. For his contributions in the field of metallurgy and outstanding leadership in physical metallurgy, he was awarded the James Douglas Medal (1929), the John Fritz Medal (1938), the Institute of Metals Medal (1941), the Franklin Institute Medal (1942), and the American Society for Metals Gold Medal (1951). Dr Merica was an honorary member of the American Institute of Mining and Metallurgical Engineers, of which he was a former vice-president and director, as well as of the American Society for Metals.

Raw Material Markets

Iron and Steel

Consumers of pig-iron are able to obtain their requirements in the grades of their choice, without difficulty. Only in some of the low-phosphorus irons is there any tendency for demands not to be satisfied fully and this can usually be overcome by the substitution of other grades. The increases in output of pig-iron to record levels in recent months have been mainly due to higher production from new furnaces and also from the reconstructed larger units, chiefly for the supply of basic steelmaking pig-iron, ample supplies of which are now available. Home sources and imported supplies provide appreciable quantities for stock, and if demand justified them, increased deliveries could be made by home producers.

Raw materials at the furnaces are at a good level. Imports of foreign ore have risen appreciably, and home supplies are maintained. These provide the furnaces with a satisfactory stock which is aimed for now, as transport difficulties may interfere with deliveries later on.

Ample supplies of most grades of foundry irons are at the disposal of the foundries, which, however, are not taking up all available tonnages. The engineering and speciality foundries continue to call for appreciable quantities of low-phosphorus irons and these demands roughly balance outputs. Hematite pig-iron is also freely used by them and their needs are fully satisfied. These foundries continue to obtain improved outputs chiefly for high-duty castings for the motor vehicle trade. The other trades for which they cater are also providing them with a reasonable amount of business. Refined iron, when called for, can be obtained without difficulty.

Outputs of high-phosphorus pig-iron are at about the same level, and are more than sufficient to cover present demands. While many of the jobbing foundries are fairly well employed, the light foundries show little change in their trading position and the textile foundries are not much better employed. Demands for light castings in particular are very subdued and prospects of any improvement are not very bright, as the trades to which they supply castings are likely to suffer further reverses due to the financial situation.

Appreciable tonnages of most grades, apart from low-phosphorus irons, are in stock, and available for export, but as many overseas producers also have tonnages to spare, competition is keen.

Most foundries have adequate supplies of scrap. Heavy cast-iron and machinery scrap are in fair demand and medium and light scrap is plentiful. Many of the foundries would prefer a larger supply of Welsh foundry coke than is being received, but supplies remain scarce. Other grades are more in keeping with requirements. Ganister, limestone, and firebricks are readily available.

The re-rollers maintain a fairly good level of outputs, but the demand for small bars and light sections has not yet reached anywhere near the tonnage which was called for some months back, particularly from the re-rolling mills in the English Midlands. Reinforcing rods are still in heavy demand, and the sheet re-rollers are also fairly well engaged.

The re-rollers appear to have no difficulty in covering for requirements of steel semis; in fact, the steelworks' capacity in some instances is at present greater than demand, so that increased business is needed to keep plants fully employed. With fairly good stocks available, mostly in the medium-sized billets, the re-rollers have been very cautious in specifying for further tonnages. Imports, however, have fallen and, as stocks dwindle, it is expected that there will be an upsurge in demand. Many of the steelworks have stocks of defectives and crops, which they find difficult to sell.

Non-ferrous Metals

Informed opinion is still in a molten state on the question of whether copper has touched the bottom of its present downtrend. However, even those who aver that it has grounded are not prepared to match their beliefs with actions, so that the downward movement continues. It was perhaps unfortunate there was no follow through last week after President Eisenhower's "chins up" speech which lifted the LME quotation over two points above a price representing a seven-year low.

Surprisingly enough, demand for copper in the United States is better than on this side of the Atlantic and producers are getting rid of fair quantities at 27 cents and custom smelters at 25½ cents per pound. The US scrap market is also reasonably firm, due to the small amounts being made available to the market. Confirmation of the better trend is that stocks in the hands of producers and consumers in September last decreased by as much as 20,000 tons.

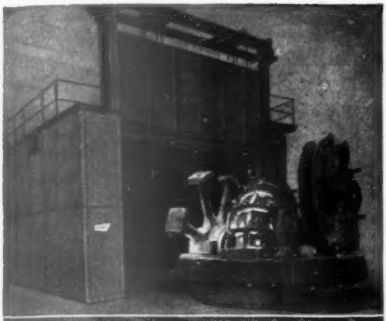
The International Tin Council's meeting in London last week has yielded the information that the buffer stock acquired 3,916 tons of tin on cash and forward contracts by the end of last June. During this time the cash price was never lower than £760 a ton and three months never below £758 a ton, whereas, currently, the spot price is bumping along on the bottom of its price support point, with three months metal several points lower. This would give credence to the belief that the buffer stock manager is only concerned with the cash quotation. The council also revealed that its revised estimate of the current year's tin surplus is now put at 12,500 tons, which compares with its earlier estimate of approximately 6,000 tons. The revision is apparently due to the taking into account of the tonnage reaching the market from Russia, but does not include the stockpile from the Board of Trade which will be available to the market and totals 2,700 tons.

Lead remains featureless, although demand is still good on this side of the Atlantic with only a small margin of supplies overhanging the market. Zinc is also quiet on the LME, but demand is satisfactory in America, where increasing interest is being shown in high-grade metal. The offtake from galvanizers has also improved lately. Buying from the automotive industry is expected to expand in the weeks ahead.

Delta Metal Offer for Sanbra

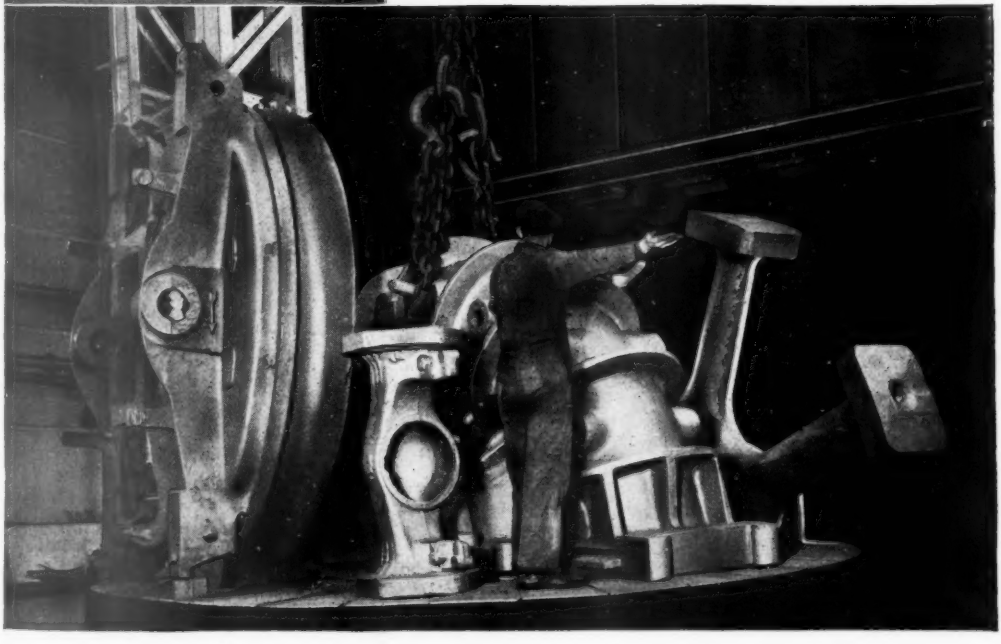
Sanbra, Limited, sanitary brassfounders, of Birmingham, has received an offer from the Delta Metal Company, Limited, London, S.E.10. Delta Metal, which already holds a substantial share interest in the company, has offered to acquire the remainder of the ordinary on the basis of 1s. cash for each 1s. ordinary, and the allotment of one Delta Metal 5s. share for every 10 Sanbra ordinary.

The directors of Sanbra intend recommending the offer for acceptance and full details are to be circulated. The company's total issued ordinary capital is £364,000. There is also £60,000 in 6 per cent. 10s. preference in issue.



The World's Largest Mechanical Shot Blast Room Plant

The Tilghman's Wheelabrator Room Plant shown in the accompanying illustrations is 30ft. by 25ft. by 16ft. high, and is installed at Messrs. F. H. Lloyd and Co. Ltd., Wednesbury. This plant, which is fitted with five Wheelabrator units, handles the production from two large bays, the components being loaded on to a bogie equipped with a circular table. Rotating and oscillating motions are provided to the bogie during the cleaning cycle, ensuring maximum blast coverage.



TILGHMAN'S LIMITED, BROADHEATH, ALTRINCHAM, CHESHIRE

LONDON OFFICE: 1, Chester Street, S.W.1. A member of the Staveley Coal and Iron Co. Ltd. Group.

AGENTS.—MIDLANDS: R. J. Richardson & Sons Ltd., Commercial Street, Birmingham 1.
SCOTLAND: Balbardie Ltd., 227, Bath Street, Glasgow, C.2; 110, Hanover Street, Edinburgh, 2.
W. 179 NORTHERN IRELAND: W. E. Stewart, 16, Sussex Place, Belfast.

Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

October 30, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £23 17s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £24 1s. 3d.

Scotch Iron.—No. 3 foundry, £25 3s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 19s. 0d.; South Zone, £26 1s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £27 6s. 6d.; South Zone, £27 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £25 6s. 6d.; Scotland (Scotch iron), Zone S. 1, £25 13s. 0d.; Sheffield, £26 15s. 0d.; Birmingham, £27 4s. 0d.; Wales (Welsh iron), £25 6s. 6d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leics.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £52 15s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 9s. 2d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 12s. 2d. per lb. of W.

Ferro-chrome (6-ton lots and over).—4/6 per cent. C, £96 0s. 0d. to £99 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. per unit; over 6 per cent. C, £94 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 33s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr.; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3d. to 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3½d. to 2s. 3¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3¾d. to 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 3d. to 7s. 10½d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 0d. to 23s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £87 19s. 3d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £33 1s. 6d.; tested, 0.08 to 0.33 per cent. C, £34 1s. 6d.; hard (0.41 to 0.60 per cent. C), £35 3s. 0d.; silico-manganese, £44 2s. 6d.; free-cutting, £37 5s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £41 7s. 0d.; silico-manganese, £44 10s. 0d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.33 per cent. C, £38 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £39 18s. 6d.; acid, up to 0.25 per cent. C, £43 10s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £42 12s. 0d.; boiler plates (N.-E. Coast), £45 2s. 0d.; floor plates (N.-E. Coast), £44 1s. 0d.; angles, N.-E. Coast, £40 6s. 6d.; joists, N.-E. Coast, £40 2s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., and flats, 5 in. wide and under, untested soft basic, 50 tons and over, £40 8s. 0d. (under 10 tons to 4 tons, £41 5s. 6d.; under 4 tons to 2 tons, £41 10s. 6d.); hoop and strip, coils, £40 10s. 0d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £45 16s. 0d.; black sheets (hand mill), 24 g., 59 4s. 6d.; galvanized corrugated sheets, 24 g., £68 17s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £69 9s. 6d., nickel-chrome, £100 12s. 6d.; nickel-chrome-molybdenum, £112 16s. 6d.

NON-FERROUS METALS

Copper.—Cash, £189 0s. 0d. to £190 0s. 0d.; three months, £192 0s. 0d. to £192 10s. 0d.; settlement, £190 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 1s. 9d. per lb.; rods, 208s. 6d. per cwt. basis; 20 s.w.g., 241s. 9d. per cwt.

Tin.—Cash, £730 0s. 0d. to £730 10s. 0d.; three months, £724 0s. 0d. to £724 10s. 0d.; settlement, £730 10s. 0d.

Lead (Refined Pig).—First half November, £85 12s. 6d. to £85 15s. 0d.; first half February, £86 5s. 0d. to £86 10s. 0d.

Zinc.—First half November, £70 10s. 0d. to £71 0s. 0d.; first half February, £70 0s. 0d. to £70 5s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations £103 0s. 0d.; rolled zinc (boiler plates), all English destinations, £102 15s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £85.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 5⅝d. per lb.; sheets to 10 w.g., 158s. 0d. per cwt.; wire, 2s. 3½d.; rolled metal, 158s. 0d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £137; B6 (85/15), — ; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £184; HTB2 (38 tons), — ; HTB3 (48 tons), — .

Gunmetal.—BS1400, LG2 (85/5/5/5), £169; LG3 (86/7/5/2), £181; G1 (88/10/2/½), £239; (88/10/2/1), £226.

Phosphor Bronze.—BS1400, PB1 (AID released), £250 per ton.

Phosphor Bronze Strip, etc.—Strip, 233s. 6d. per cwt.; sheets to 10 w.g., — per cwt.; wire, 3s. 6½d. per lb.; rods, 2s. 10½d.; tubes, 2s. 11½d.; chill cast bars: solids 2s. 10½d., cored 2s. 11½d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 5½d. per lb.; round wire, 10g. in coils (10 per cent.), 3s. 10½d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 9½d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £74 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, £214; AB2, — .

* Average 68-70 per cent.